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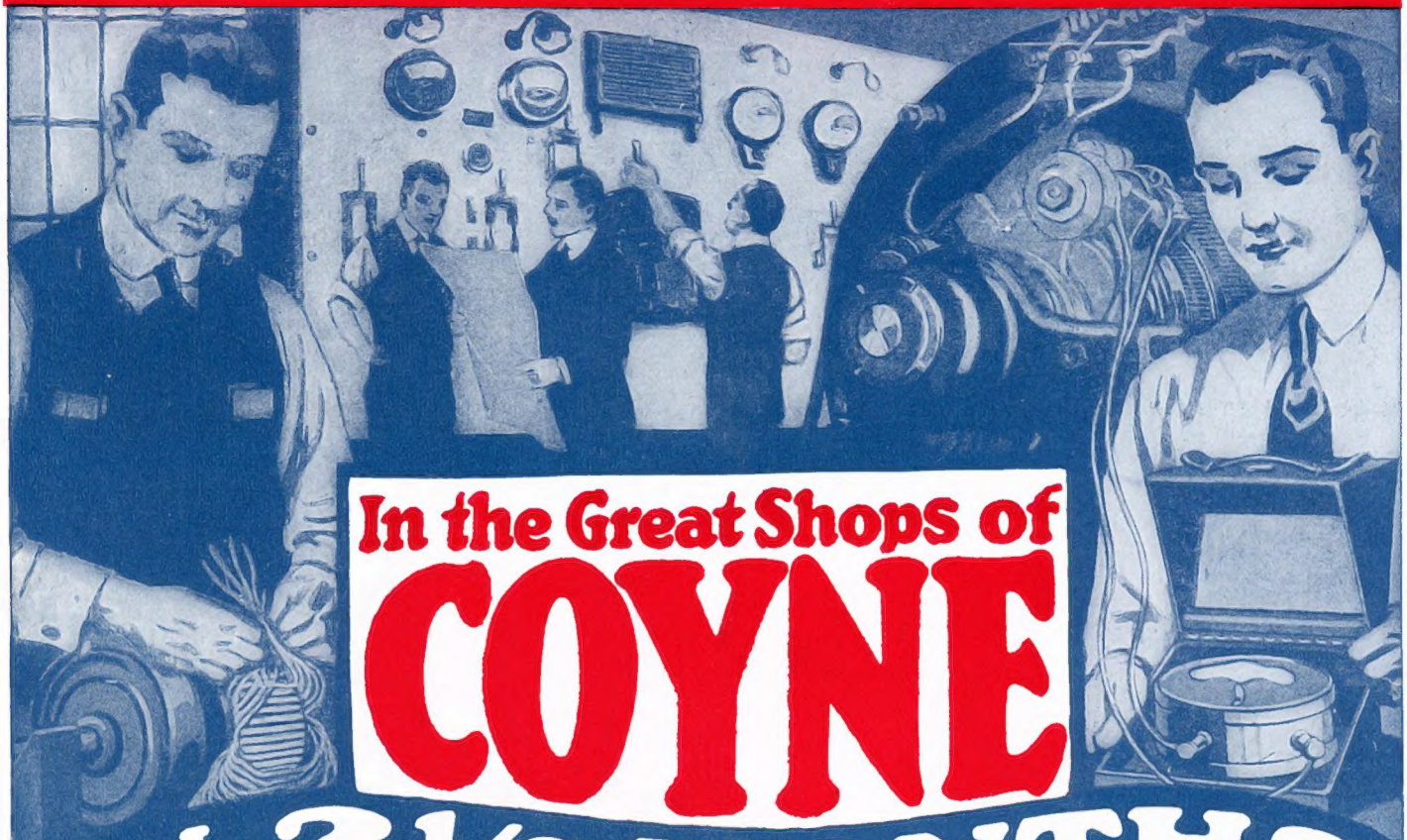

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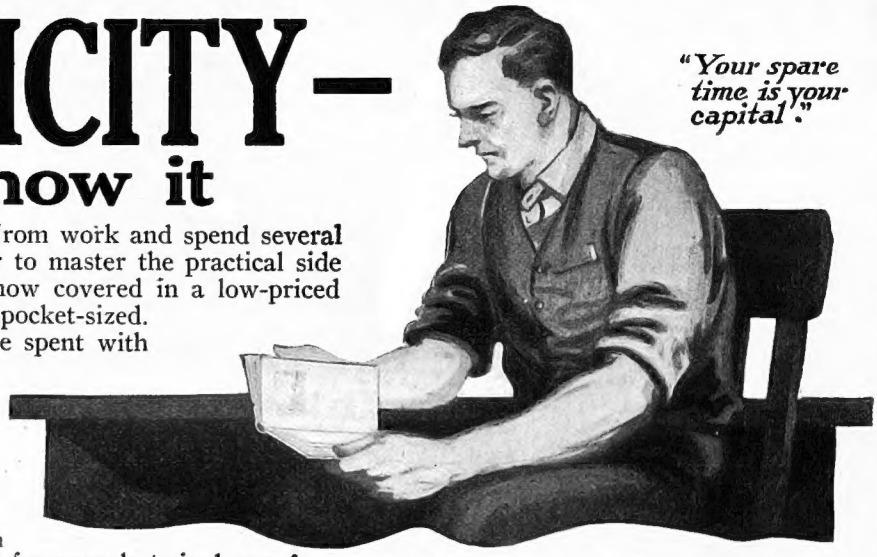

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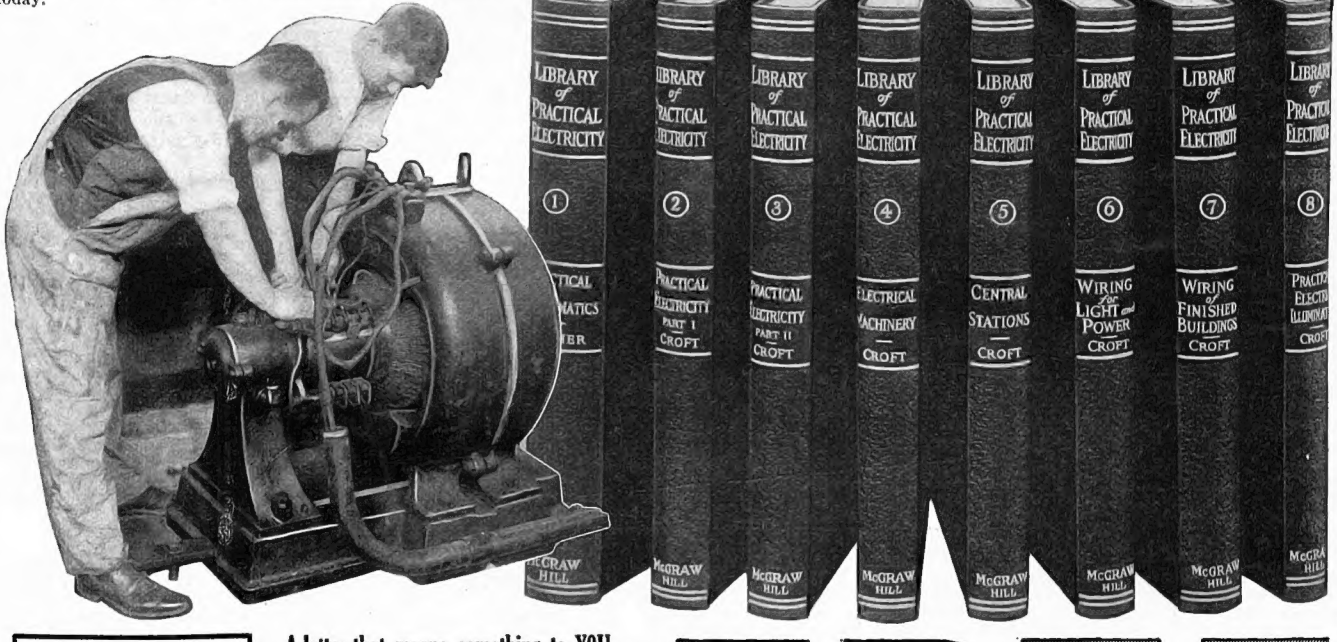

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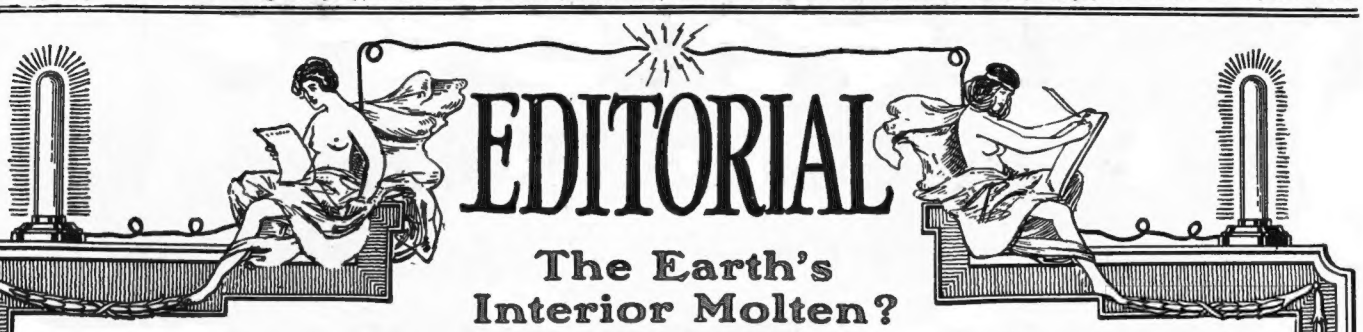

EDITORIAL

The Earth's Interior Molten?

MANY things that we take for granted sometimes turn out to be very much different than we first thought them to be. Take for instance the earth's interior. Our physics instructors and scientists taught us for years that the earth was once a huge molten sphere, just beginning to cool down. The interior and center is supposed to be entirely fluid—a huge molten mass where all the known elements "including rocks" are in a liquid state, at a tremendously high temperature running up into thousands of degrees Fahrenheit. Our physics instructors by way of impressing us were wont to tell us that the hard crust of the earth is just about as thick in proportion to the rest of the earth as the peel is to an orange.

And in order that we could not doubt their words our instructors give us "proofs" to back up their contentions.

First, we are pointed out that the volcanoes—the ventholes of the liquid earth's interior—prove that the earth is fluid inside. Witness the many volcanic eruptions belching forth molten rock, lava and brimstone. And to further disarm our suspicions we are shown that as we descend into the earth's interior, the temperature rises one degree Fahrenheit for every 40 to 50 feet. It matters not where we bore a hole or sink a shaft into the earth's interior; the rise of temperature as we descend is pretty uniform the world over, even in high latitudes. These are both *facts*, well authenticated and are not doubted by any sane person.

But recently scientists began wondering if these facts really proved that the earth's interior was in a molten state. And the more they wondered the more they learned. For one thing they said: If the earth's interior is really in a molten state, liquid in other words, why does not this molten mass rise and fall with the tides which undoubtedly *it would do* were it liquid or even plastic. Accurate measurements, however, show that there is no such tide in the interior of the earth. If there were, the crust of the earth, due to the tidal effects of the moon and the sun, would constantly rise and fall, for one thing, and we would have extensive daily earthquakes. But, you will say, the earth's crust is so solid that there may well exist a tide inside of the earth that we cannot perceive. This is hardly even probable, however, because in that case the gigantic tidal effects created—a million times greater than any ocean tide—would burst thru the earth's crust in short order. Do not forget that if the orange peel analogy holds good, there will be a liquid mass some 7,000 miles deep! Contrast that with the average depth of the ocean of less than one mile and then figure out the gigantic tides a liquid interior would produce!

But our modern scientist does not stop there. He goes and counts the very few active volcanoes and finds that as ventholes for a molten globe 7,000 miles in diameter, they appear preposterous. These few holes could no more serve as vents for this big globe than you could vent an armory with a soda straw.

On top of this our astronomers come along and prove mathematically, without a shade of doubt, that *the earth is at least as rigid as steel.*

But how explain the volcanoes and our deep hot shafts? Our scientists prefer to think—and they can prove it, too, that the earth's interior is not molten. The volcanoes are merely ventholes for local molten pockets. The earth's heat is produced by *radium*, or rather *radioactivity*. And while the earth's interior is hot—very hot—it is not fluid.

While boring the famous Simplon tunnel, many hundred feet *above* sea level, the heat became unbearable and artificial cooling became necessary. Recent tests showed that the radium contents of the rock could easily produce this great heat.

The solution of the earth's heat, then, doubtless is *radium.*

H. GERNSBACK.

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By Charles F. Haanel

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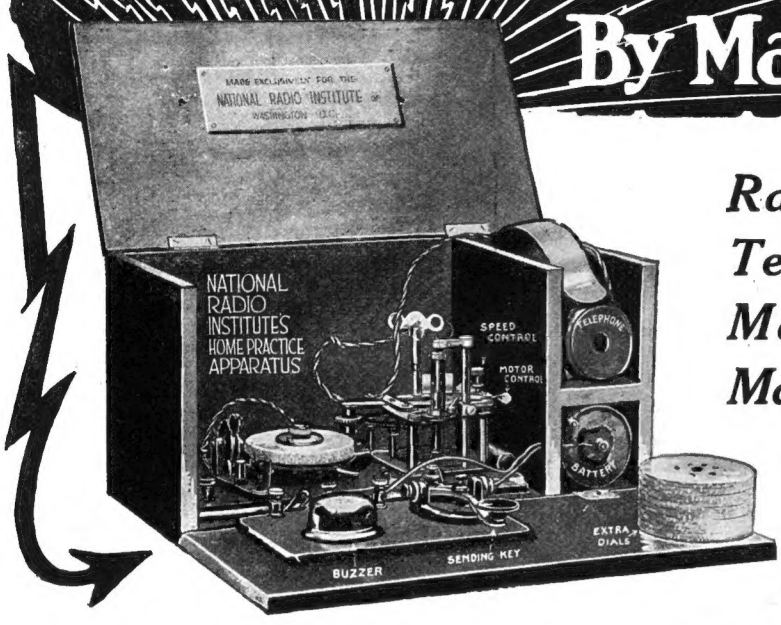

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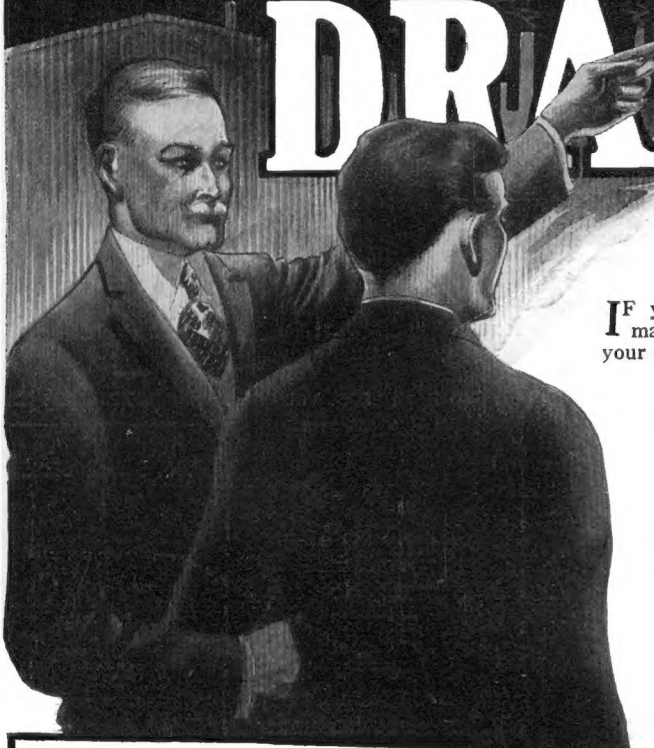

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How Columbia Students Succeed

(More letters on request)

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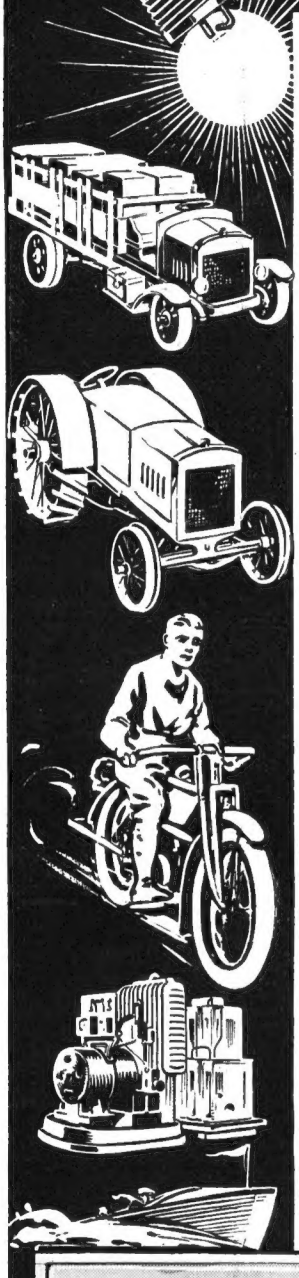

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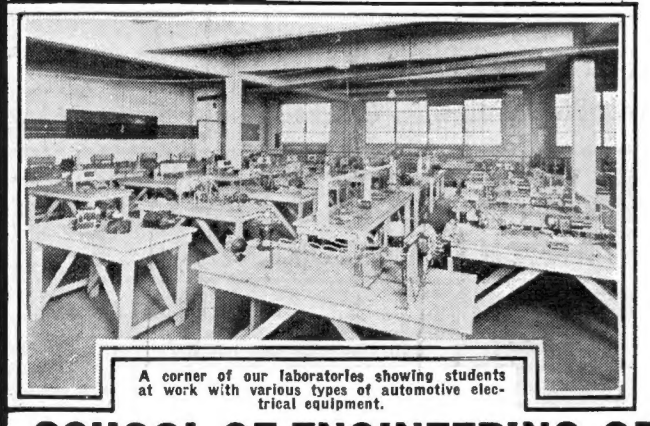

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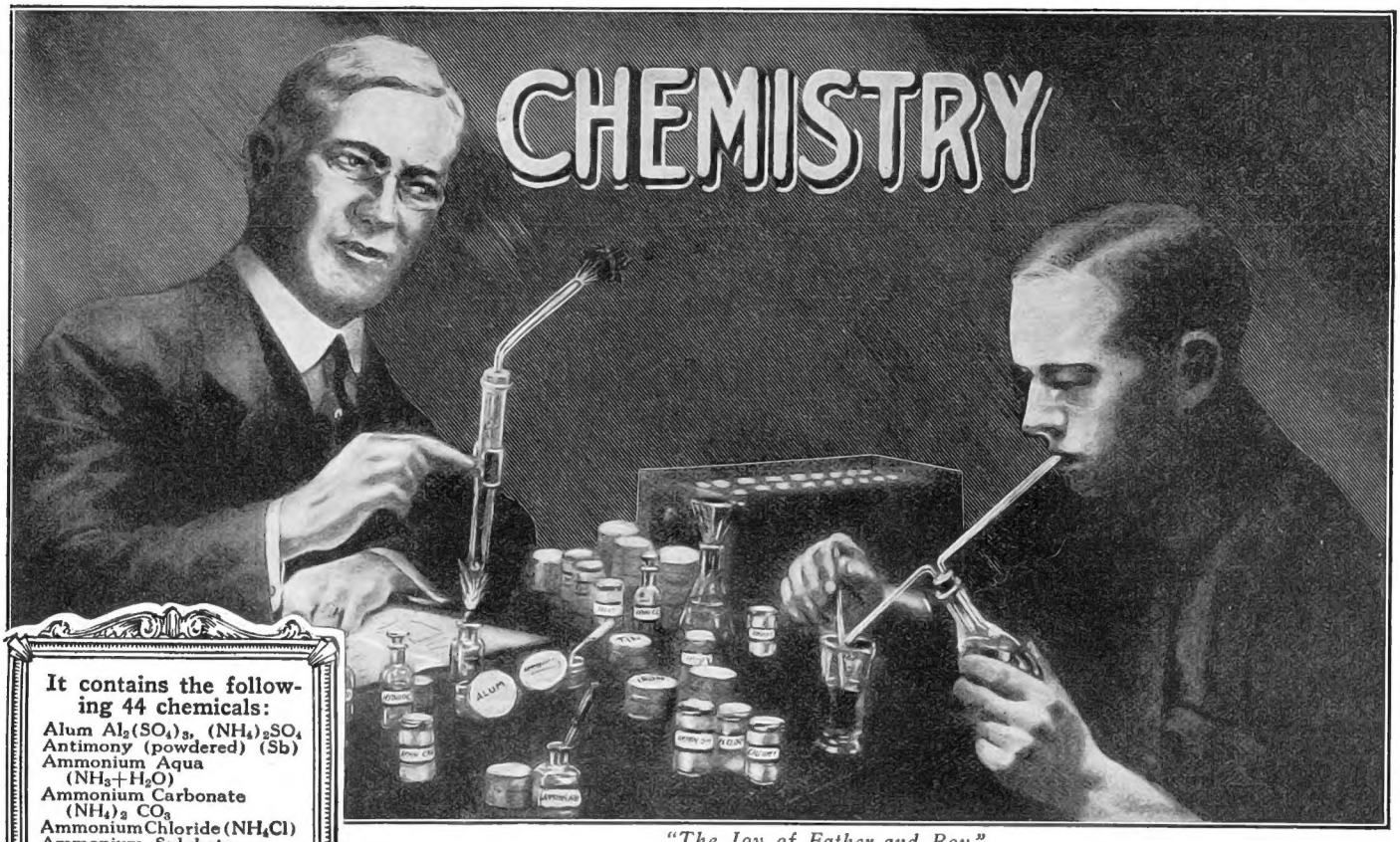

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The outfit consists of forty-four (44) Chemicals all C. P. (chemical pure) put up in appropriate wooden boxes, glass bottles, and hermetically closed jars. The acids are put up in glass bottles, with ground-in glass stoppers and there is a sufficient quantity of chemicals supplied (mostly one to two ounces) enough to make dozens of experiments with each. See list of Chemicals herewith.

The apparata furnished are all of the best obtainable make and of standard laboratory size and shape. A list of the 17 pieces of apparata furnished with this outfit is printed also herewith.

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A good part of the book is devoted to Weights and Measures. The Metric System, the English system and the U. S. System are fully explained.

The following tables are furnished: Symbols and Atomic weights of the Elements; Measures of Weights, Volume, Capacity and Length; Per Cent solutions; Conversion of Measure expressed in parts; Poisons and their antidotes; Technical and common name of chemical substances; Formulas for Cleaning various substances, etc., etc.

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Ammonium Aqua (NH_3+H_2O)
Ammonium Carbonate $(NH_4)_2\ CO_3$
Ammonium Chloride (NH_4Cl)
Ammonium Sulphate $(NH_4)_2\ SO_4$
Barium Chloride $(BaCl_2)$
Boric Acid (H_3BO_3)
Brimstone (Sulphur) (S)
Calcium Chloride $(CaCl_2)$
Calcium Oxide (CaO)
Calcium Sulphate $(CaSO_4 2H_2O)$
Charcoal (Carbon) (C)
Chloride of Zinc $(ZnCl_2)$
Copper Sulphate $(CuSO_4)$
Ferrous Sulphate $(FeSO_4)$
Ferrous Sulphide (FeS)
Glycerol (Glycerine) $C_3H_5(OH)_3$
Hydrochloric Acid (HCl)
Iodine (I)
Iron Chloride $(FeCl_2)$
Iron Oxide (Fe_2O_3)
Lead Acetate Pb $(C_2H_3O_2)_2$
Litmus Paper
Magnesium Carbonate $(MgCO_3)$
Manganese Dioxide (MnO_2)
Mercury (Quicksilver) (Hg)
Nickel Chloride $(NiCl_2)$
Oxalic Acid $(H_2C_2O_4)$
Sodium Bicarbonate $(NaHCO_3)$
Sodium Borate $(NaBO_2)$
Sodium Carbonate (Na_2CO_3)
Sodium Chloride (NaCl)
Sodium Nitrate $(NaNO_3)$
Sodium Phosphate (Na_2HPO_4)
Sodium Sulphate (Na_2SO_4)
Sodium Sulphite (Na_2SO_3)
Stannous Chloride $(SnCl_2)$
Sulphate of Nickel $(NiSO_4$
Sulphate of Zinc $(ZnSO_4)$
Sulphuric Acid (H_2SO_4)
Tin (Granulated) (Sn)
Zinc (Metal) (Zn)
Zinc Carbonate $(ZnCO_3)$

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A Startling Memory Feat That You Can Do

How I learned the secret in one evening. It has helped me every day

WHEN my old friend Faulkner invited me to a dinner party at his house, I little thought it would be the direct means of getting me a one-hundred-and-fifty per cent. increase in salary. Yet it was, and here is the way it all came about.

Toward the close of the evening things began to drag a bit, as they often do at parties. Finally some one suggested the old idea of having everyone do a "stunt." Some sang, others forced weird sounds out of the piano, recited, told stories, and so on.

Then it came to Macdonald's turn. He was a quiet sort of chap, with an air about him that reminded one of the old saying that "still waters run deep." He said he had a simple "stunt" which he hoped we would like. He selected me to assist him. First he asked to be blindfolded securely to prove there was no trickery in it. Those present were to call out twenty-five numbers of three figures each, such as 161, 249, and so on. He asked me to write down the numbers as they were called.

This was done. Macdonald then astounded everyone by repeating the entire list of twenty-five numbers backwards and forwards. Then he asked people to request numbers by positions, such as the eighth number called, the fourth number, and so on. Instantly he repeated back the exact number in the position called. He did this with the entire list—over and over again, without making a single mistake.

Then Macdonald asked that a deck of cards be shuffled and called out to him in their order. This was done. Still blindfolded, he instantly named the cards in their order backwards and forwards. And then to further amaze us, he gave us the number of any card counting from the top, or the card for any number.

You may well imagine our amazement at Macdonald's remarkable feat. You naturally expect to see a thing of this sort on the stage, and even then you look upon it as a trick. But to see it done by an everyday business man, in plain view of everyone, blindfolded and under conditions which make trickery impossible, is astonishing, to say the least.

ON THE way home that night I asked Macdonald how it was done. He said there was really nothing to it—simply a memory feat, the key to which anyone could easily learn in one evening. Then he told me that the reason most people have bad memories is because they leave memory development to chance. Anyone could do what he had done, and develop a good memory, he said, by following a few simple rules. And then he told me exactly how to do it. At the time I little thought that evening would prove to be one of the most eventful in my life, but such it proved to be.

What Macdonald told me I took to heart. In one evening I made remarkable strides toward improving my memory and it was but a question of days before I learned to do exactly what he had done. At first I amused myself wth my new-found ability by amazing people at parties. My "memory feat," as my friends called it, surely made a hit. Every one was talking about it, and I was showered with invitations for all sorts of affairs. If anyone were to ask me how quickly to develop social popularity, I would tell him to learn my memory "feat"—but that is apart from what I want to tell you.

The most gratifying thing about the improvement of my memory was the remarkable way it helped me in business. Much to my surprise I discovered that my memory training had literally put a razor edge on my brain. My brain had become clearer, quicker, keener. I felt that I was fast acquiring that mental grasp and alertness I had so often admired in men who were spoken of as "wonders" and "geniuses."

The next thing I noticed was a marked improvement in my conversational powers. Formerly my talk was halting and disconnected. I never could think of things to say until the conversation was over. And then, when it was too late, I would always think of apt and striking things I "might have said." But now I can think like a flash. When I am talking I never have to hesitate for the right word, the right expression or the right thing to say. It seems that all I have to do is to start to talk and instantly I find myself saying the very thing I want to say to make the greatest impression on people.

It wasn't long before my new-found ability to remember things and to say the right thing at the right time attracted the attention of our president. He got in the habit of calling me in whenever he wanted facts about the business. As he expressed himself to me, "You can always tell me instantly what I want to know, while the other fellows annoy me by dodging out of the office and saying 'I'll look it up.'"

* * * * * * *

I FOUND that my ability to remember helped me wonderfully in dealing with other people, particularly in committee meetings. When a discussion opens up the man who can back up his statements quickly with a string of definite facts and figures usually dominates the others. Time and time again I have won people to my way of thinking simply because I could instantly recall facts and figures. While I'm proud of my triumphs in this respect, I often feel sorry for the ill-at-ease look of the other men who cannot hold up their end in the argument because they cannot recall facts instantly. It seems as though I never forget anything. Every fact I now put in my mind is as clear and as easy to recall instantly as though it were written before me in plain black and white.

We all hear a lot about the importance of sound judgment. People who ought to know say that a man cannot begin to exercise sound judgment until he is forty to fifty years of age. But I have disproved all that. I have found that sound judgment is nothing more than the ability to weigh and judge facts in their relation to each other. Memory is the basis of sound judgment. I am only thirty-two, but many times I have been complimented on having the judgment of a man of forty-five. I take no personal credit for this—it is all due to the way I trained my memory.

* * * * * * *

THESE are only a few of the hundreds of ways I have profited by my trained memory. No longer do I suffer the humiliation of meeting men I know and not being able to recall their names. The moment I see a man his name flashes to my mind, together with a string of facts about him. I always liked to read but usually forgot most of it. Now I find it easy to recall what I have read. Another surprising thing is that I can now master a subject in considerably less time than before. Price lists, market quotations, data of all kinds, I can recall in detail almost at will. I rarely make a mistake.

My vocabulary, too, has increased wonderfully. Whenever I see a striking word or expression, I memorize it and use it in my dictation or conversation. This has put a remarkable sparkle and pulling power into my conversation and business letters. And the remarkable part of it all is that I can now do my day's work quicker and with much less effort, simply because my mind works like a flash and I do not have to keep stopping to look things up.

All this is extremely satisfying to me, of course. But the best part of it all is that since my memory power first attracted the attention of our president, my salary has steadily been increased. Today it is many times greater than it was the day Macdonald got me interested in improving my memory.

* * * * * * *

WHAT Macdonald told me that eventful evening was this: "Get the Roth Memory Course." I did. That is how I learned to do all the remarkable things I have told you about. The publishers of the Roth Memory Course—The Independent Corporation—are so confident that it will also show you how to develop a remarkable memory that they will gladly send the Course to you on approval.

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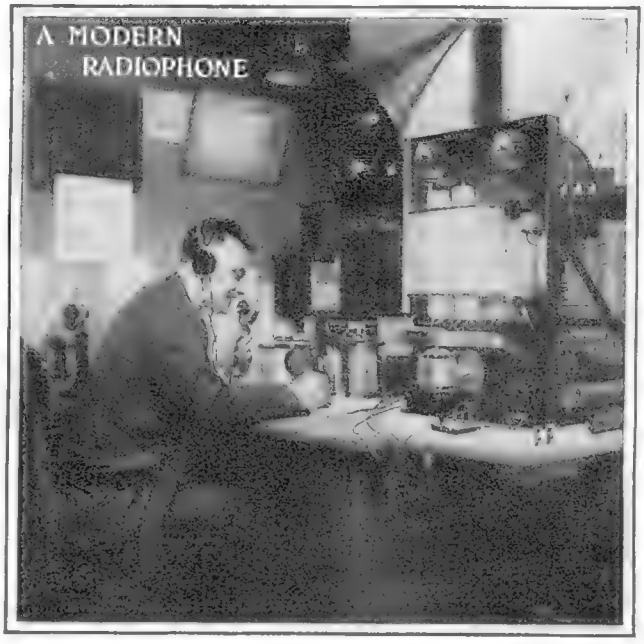

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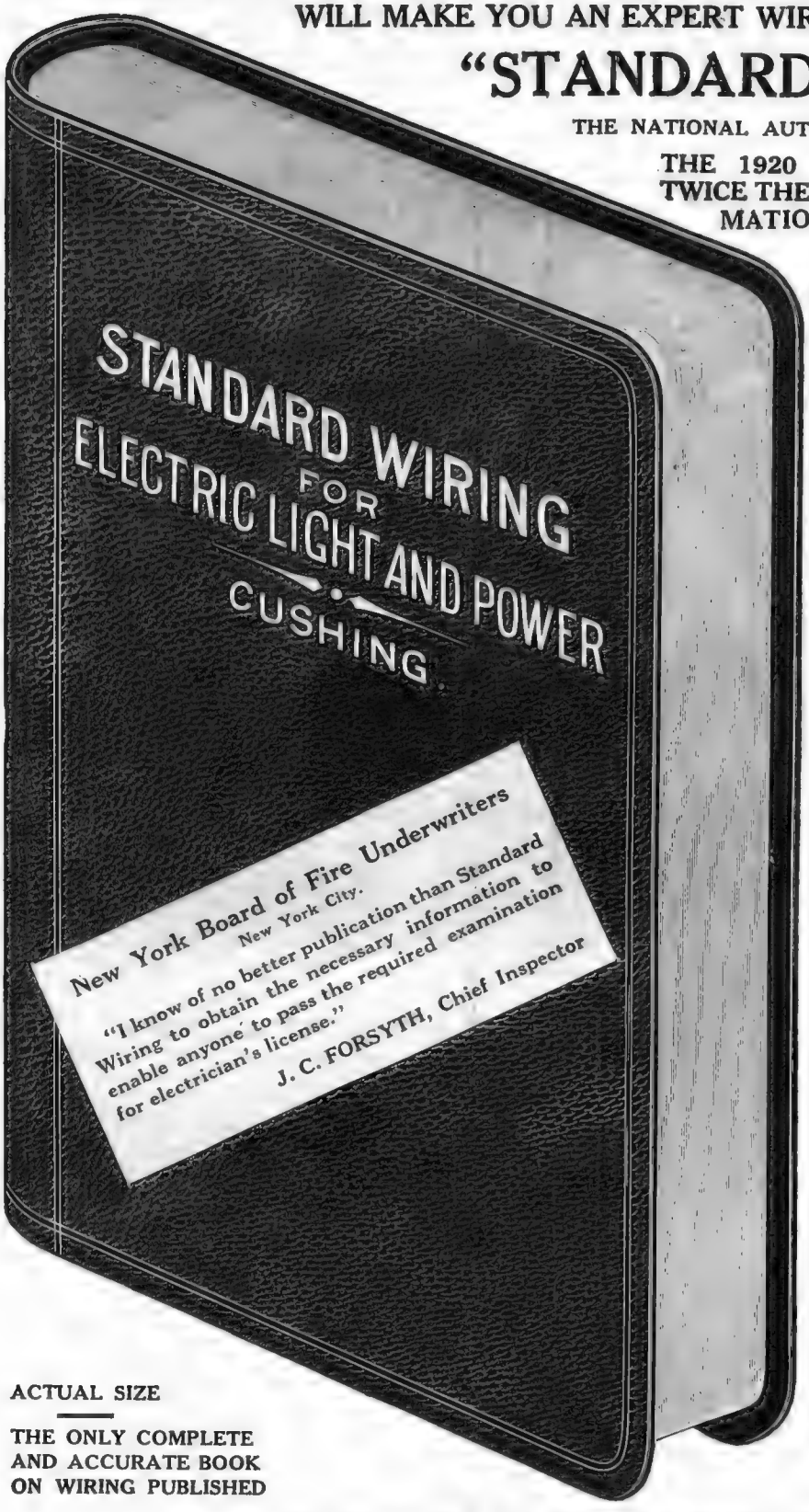
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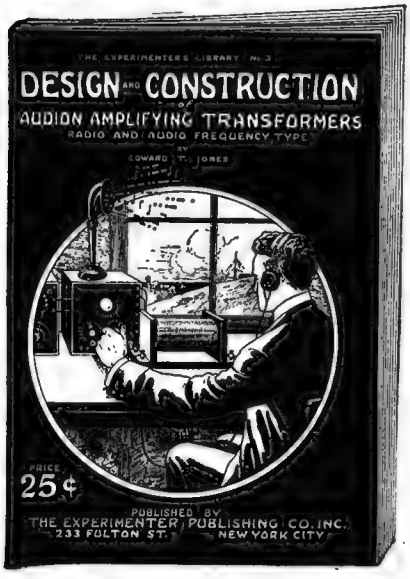

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Write this circle at the **beginning** of | and you will have Ed. ◡

By letting the circle remain **open** it will be a **hook,** and this **hook** stands for **A.** Thus ◡ will be **Ad.** Add another **A** at the end, thus ◡ and you will have a girl's name, **Ada.**

From *o* eliminate the initial and final strokes and ○ will remain, which is the Paragon symbol for **O.**

For the **longhand** *m* , which is made of 7 strokes, you use this **one** horizontal stroke —

Therefore, — would be **Me.**

Now continue the **E** across the **M,** so as to add **D**—thus ⌐ and you will have **Med.** Now add the **large** circle for **O,** and you will have ⌐○ (medo), which is **Meadow,** with the silent **A** and **W** omitted.

Paragon writers are all over the world: in England, Continental Europe, Australia, New Zealand, Canada, South Amercia, Canal Zone, China, Philippine Islands and in all other civilized places. Paragon Shorthand is used in the offices of Standard Oil Company, United States Steel Corporation, many of the great Railway Systems, the largest firms and corporations in the world.

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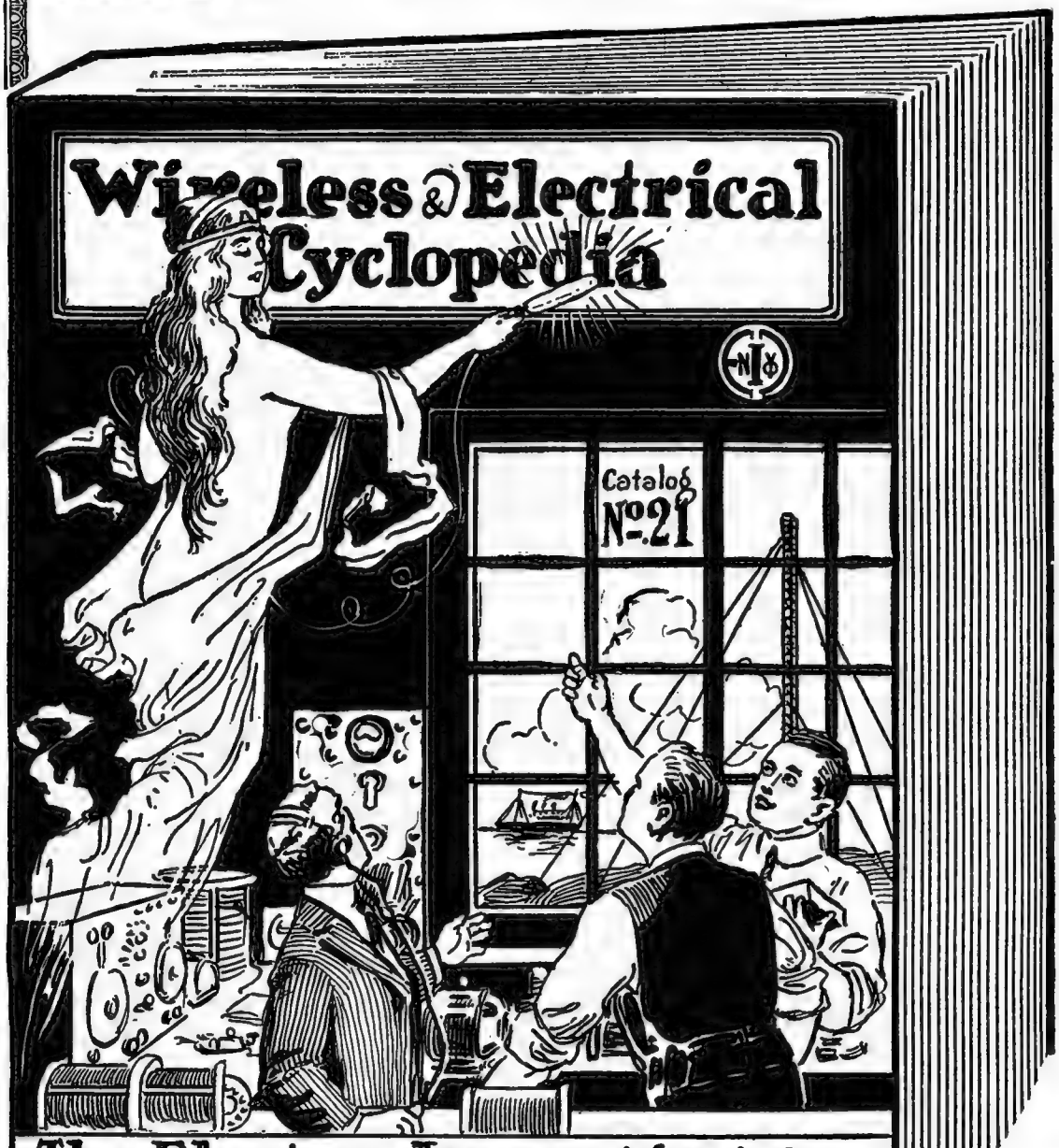

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By A. L. Pelton

MY name is Pelton — Albert L. Pelton. Four years ago I was as poor as a church mouse. I was out of a job, $300 in debt, and my wife and two children were living on starvation rations. Yes, I've known the bitterest kind of want.

Today I have money and all that money will buy. I have my own home. I have no worries about high prices of food or clothing or rent.

Even if I never make another nickel, I don't think I will ever have to worry about money matters.

During the past three years I have been making on an average of over a thousand dollars a week.

That's quite a change from the time I was "on my uppers", isn't it?

Now let me tell you how I did it.

You will probably think I'm funny when I tell you that for twelve years I held in my hand the secret that at last won me riches.

But it's true.

For twelve years I struggled—with gold right in my hand.

It was this way.

I used to sell books—from door to door—eking out a poor man's living.

One of the books I sold was written by Dr. Frank Channing Haddock.

I never thought much about the book—although I sold a few from week to week.

For twelve years I never even took the trouble to read it.

It was called "Power of Will".

I didn't know anything about will power.

What's more, I didn't care.

I thought it might be a good book for fellows who *had* to read it.

But I was too busy earning a living to bother about will power.

Probably I thought then, as tens of thousands think today, who've heard and read about this great book—that will-power was some myth, or impractical thing for dreamers.

You see—I hadn't analyzed the lives of the world's greatest men then, and discovered that will-power is the mightiest force men have ever known.

I was fooling myself—cheating myself fearfully, as I found out later.

One day I ran across a man who had purchased the book from me a few months back.

He stopped me on the street and said, "Hello, Pelton, say, I'd like to have another copy of that Haddock book,—can you send it up right away?"

I told him I would. Then I asked him casually if he liked it.

What he told me made me go home and *read* the book myself—for the first time since I began to sell it twelve years before.

That same evening I borrowed $300.

The next day I was in New York.

I secured the exclusive selling rights to the book.

Then I spent $150 for a page "ad" in the Review of Reviews magazine.

It brought me about $2000 in cash.

As fast as the money came in I shot it back into advertising.

When I got $2500 in cash I bought a half page "ad" in the Saturday Evening Post.

The first year I spent $50,000 in advertising.

The next year I spent nearly a hundred thousand.

I guess I've spent over half a million dollars since my first $150 "ad", and already 450,000 men and women—including great executives, international diplomats, famous authors, etc., also have taken up this study.

At first some people said I was crazy to advertise that book.

When they found that the book was selling—and that I was spending as high as *$20,000 a month* telling people about it, they said I had more nerve than sense.

But, my friends, all this time I was simply taking my own medicine.

I was telling people that the will was the motive power of the brain—that a strong will could batter down every obstacle to success—that weak will-power could be made strong, as easily as the muscles of the arm could be made strong—and that most people had weak wills made strong—and that simply because they didn't *use* their will power.

I had strengthened my own will and was *using* it when people were calling me "crazy". And it was my *will power* that people called "nerve".

Anyway, it was the secret of my success. Without it I might still be plodding—still canvassing.

Or even if I had gotten up enough courage to advertise I might have made only a piker's success.

It was my will power that got me the $300 loan.

It was my will power that got me exclusive sale of Dr. Haddock's book.

It was my will power that made me plunge into advertising instead of going slowly.

And finally, it was my will power that made me say to the public—"Send No Money—Read Power of Will 5 days free. Pay me if you decide to keep it—Send it back if you don't want it."

That was a new sort of proposition to most people. They had nothing to lose—and a lot to gain, if the book was worth while.

So the orders came in by the hundreds—then by the thousands.

At times I was 15,000 orders behind—just couldn't print books fast enough.

And letters from readers came pouring in so fast I simply couldn't read them all. Col. S. W. Wilkie of Roscoe, S. D., wrote that one day's study of "Power of Will" netted him $300 cash, and that four years later, by using the methods Haddock formulated, his earnings had risen to nearly $1,000,000 a year. V. P. Coffin of Rochester, N. Y., wrote, about *one month* after getting the book—"'Power of Will' already has produced an increase of $5,000 a year in my income." J. F. Gibson of San Diego, Cal., said that since reading "Power of Will" his salary jumped from $150 to $800 a month.

Men like Judge Ben Lindsey, Supreme Court Justice Parker, Asst. Postmaster-General Britt, Governor McKelvie of Nebraska, Senator Capper of Kansas, Secretary of Agriculture Meredith, Governor Ferris of Michigan—and a host of other big men, show the class of leaders who have studied Haddock's methods.

Surely there must be something in "Power of Will" for you, my reader.

It helped me. It has helped half a million others. I could send you a circular mailed with hundreds of letters from readers. But, better still, see the book and read it 5 days *free*.

All you lose, if you don't think "Power of Will" will increase your earnings, is a two cent stamp.

It may make $300 for you next week—it might carry you upwards to $50,000 or $100,000 in a few years—I don't know. I do know it has made a lot of money for its readers.

I do know, too, that if you pass this offer by—if you are a scoffer and a doubter—I will lose only the small profit on the sale of a book—but you—you may lose the difference between peanut money and real money.

It costs only 2c stamp to mail the coupon.

Don't wait 12 years—as I did. You may have gold within your reach and not know it. Send for "Power of Will" *now*. You've seen my ads before—now answer this one and see if this masterful volume doesn't contain the one little push you may need to make your life rosy-red. Begin training your will by sending in the coupon *this very second*.

A. L. PELTON.

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ELECTRICAL EXPERIMENTER

H. GERNSBACK – EDITOR
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Vol. VII. Whole No. 84 April, 1920 No. 12

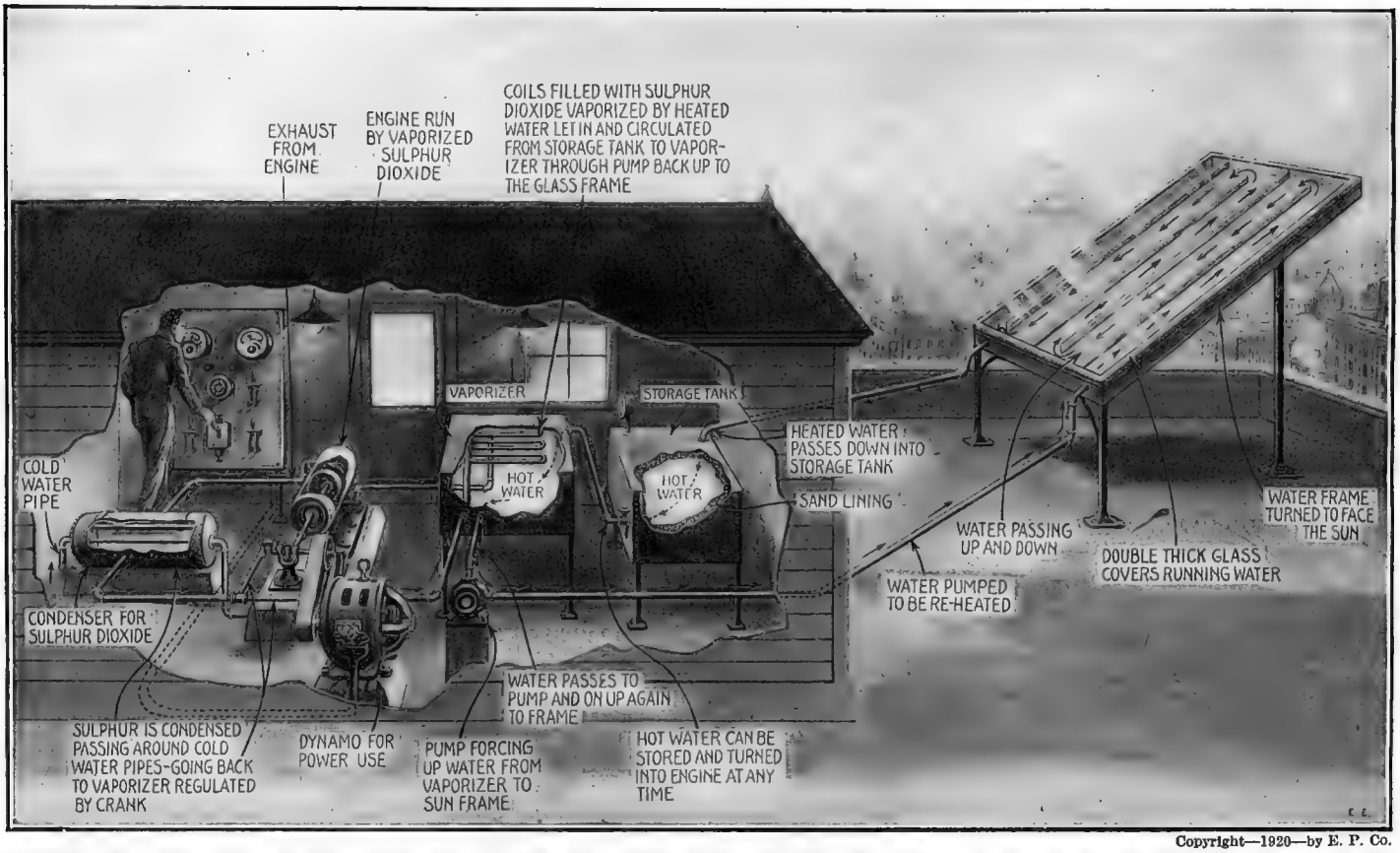
Electric Power From The Sun

FROM time to time we hear of new schemes devised by inventors for harnessing the tremendous energy shot earthward every minute of our lives by "Old Sol." An American scientist, Mr. Henry E. Willsie, has recently proposed a new form of Solar Power Plant, which comprises a number of very interesting and radical features which would seem to promise a successful future for it. Not only is Mr. Willsie a scientific theoretician, but also a man of practical deeds, and to this end he built, some years ago, a solar light and power plant on a small scale out in Arizona. The development of this plant nearly caused Mr. Willsie and his wife their lives during their many exciting adventures while experimenting in the wilds and barrenness of an Arizona desert, where sandstorms, cloudbursts, thirst and poisonous reptiles all combined to threaten their very existence. All these experiences are interestingly told in an absorbing novel written by Mrs. Honoré Willsie, entitled "The Forbidden Trail."

Coming back once more to the scientific side of Mr. Willsie's interesting invention, which is shown in the accompanying illustration in one of its applications, we learn that the underlying principle is the drawing of the heat from the sun's rays into a *moving sheet of water*, which passes up and down thru a series of zigzag passageways, under a double thickness of glass. Where the sun has considerable thermal power, particularly in the southern part of the United States and other more tropical parts of the world, experience has shown that the sun's heat will cause the temperature of the water to increase to about 150 degrees. The heated water passes into a sulfur dioxid boiler, and eventually this water returns to the glass heating tanks or planes exposed to the sun's rays.

Where a large plant of this type is properly laid out, the mirrors or glass-covered tanks in which the water or liquid is heated by the sun's rays may be arranged in a fixt position, or also they may be designed so as to swing from east to west with the sun, so as to keep the rays perpendicular to the surface at all hours of the day.

(*Continued on page* 1310)


EXHAUST FROM ENGINE
ENGINE RUN BY VAPORIZED SULPHUR DIOXIDE
COILS FILLED WITH SULPHUR DIOXIDE VAPORIZED BY HEATED WATER LET IN AND CIRCULATED FROM STORAGE TANK TO VAPORIZER THROUGH PUMP BACK UP TO THE GLASS FRAME
VAPORIZER
STORAGE TANK
HEATED WATER PASSES DOWN INTO STORAGE TANK
COLD WATER PIPE
HOT WATER
HOT WATER
SAND LINING
WATER FRAME TURNED TO FACE THE SUN
WATER PASSING UP AND DOWN
DOUBLE THICK GLASS COVERS RUNNING WATER
WATER PUMPED TO BE RE-HEATED
CONDENSER FOR SULPHUR DIOXIDE
WATER PASSES TO PUMP AND ON UP AGAIN TO FRAME
SULPHUR IS CONDENSED PASSING AROUND COLD WATER PIPES-GOING BACK TO VAPORIZER REGULATED BY CRANK
DYNAMO FOR POWER USE
PUMP FORCING UP WATER FROM VAPORIZER TO SUN FRAME
HOT WATER CAN BE STORED AND TURNED INTO ENGINE AT ANY TIME

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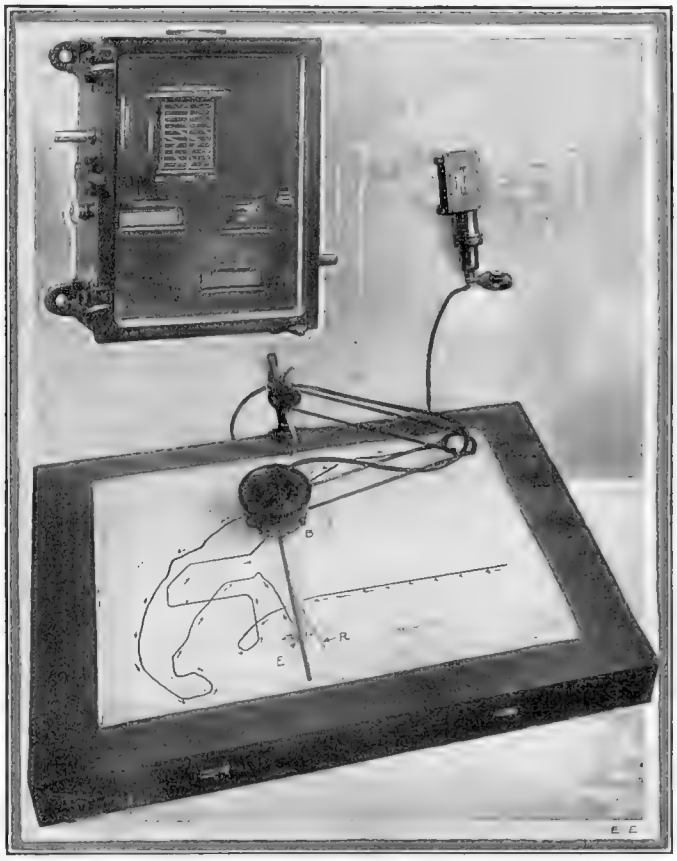
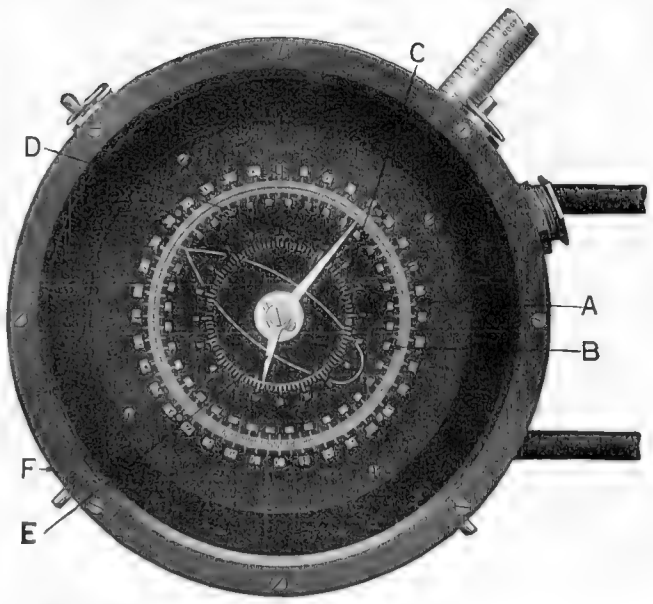
The Latest Sun-Power Electric Plant. By Following the Pipe Lines Conveying the Sun-Heated Water to the Sulfur Dioxid Boiler, and the Course Taken by the Sulfur Dioxid Steam Thru the Engine and Condenser, Thence Back to the Boiler Once More, a Clear Idea Is Had of Just How This "Free Energy" Power Plant Works.

The Battle Tracer



The Sperry "Battle Tracer" Complete, and Also Revolution Converter and Auxiliary Range Transmitter. The "Battle Tracer" Records the Course Followed by their Own as Well as the Enemy Ship. E is the Enemy Arm Tracer and R, the Range Predictor.



Close-Up View of the Battle Tracer Motor Head, Thru Which the Graduated Enemy Arm Passes. This Connects With the Various Range Finding and Spotting Apparatus on the Vessel.

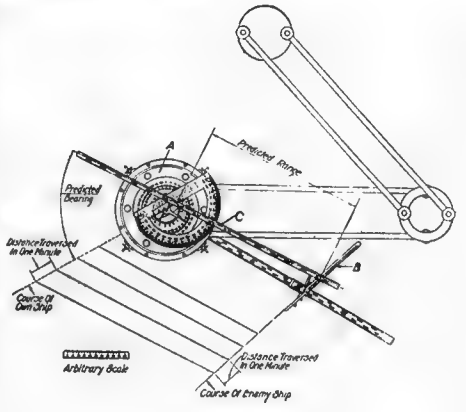


Diagram Showing How Range Is Computed Directly from "Battle Tracer" Plottings So That Guns Can Be Aimed Ahead of Time, to Hit the Enemy Ship, by "Prediction."

"YES, Captain, she was traveling at 18 knots; we were slowly closing in on her, and when 14 miles away we opened fire."

"The shells from the very first salvo struck her squarely amidship and blew her super-structure off——." Thus continued the gunnery officer's report of the Naval engagement just completed in which the very first shots found the enemy and silenced their guns before they had a chance to reply.

It is truly remarkable to think that not even a "finder" shot had been fired. In this case there was no need of firing the guns and wasting the big shells in order to get a "bead" on the fugitive vessel.

The vessel's range was computed to absolute accuracy and predetermined in time for the guns to be set and fired. All this computation with the aid of the device here mentioned *required but* 19 *seconds,* reducing thereby, past calculations several hundred per cent.

What is this remarkable equipment, you will ask. Essentially, it consists of a number of devices all working in conjunction with each other. The most important of which, perhaps, is the *Battle Tracer,* as it is called.

The object of the invention, which has proven itself to be of great practical use, is to provide a means whereby the course of our own ship is plotted automatically on a table similar to the table used for plotting navigation courses. In addition, an arm extending from the instrument proper, called the *enemy arm,* keeps track at all times of the enemy's movements. In this way, regardless of what our own ship's speed may be or what the enemy's speed may be, prediction of its probable location, allowing sufficient time for the gunners to change their range, can be made with remarkable accuracy and the guns can be fired so that very few shots will miss the target for which they were intended.

"Suppose the enemy zig-zags," you will say. "Isn't the art of shelling more a matter of mere guess work than of accuracy?" No, dear reader, no! You must remember that a ship eight to nine hundred feet long traveling at 20 knots, or perhaps, even more, cannot steer and squirm away with the same ease as an automobile.

It is not a question of a few seconds, but *minutes elapse* before one of these large floating fortresses can be turned completely in their course, particularly in view of the terrific speeds at which they move. Hence, when a computation is made via the tracer, and guns can be elevated within nineteen seconds, taking the corrected findings as data to work from; it then gives the enemy very little opportunity to change a predicted and predetermined range or bearing.

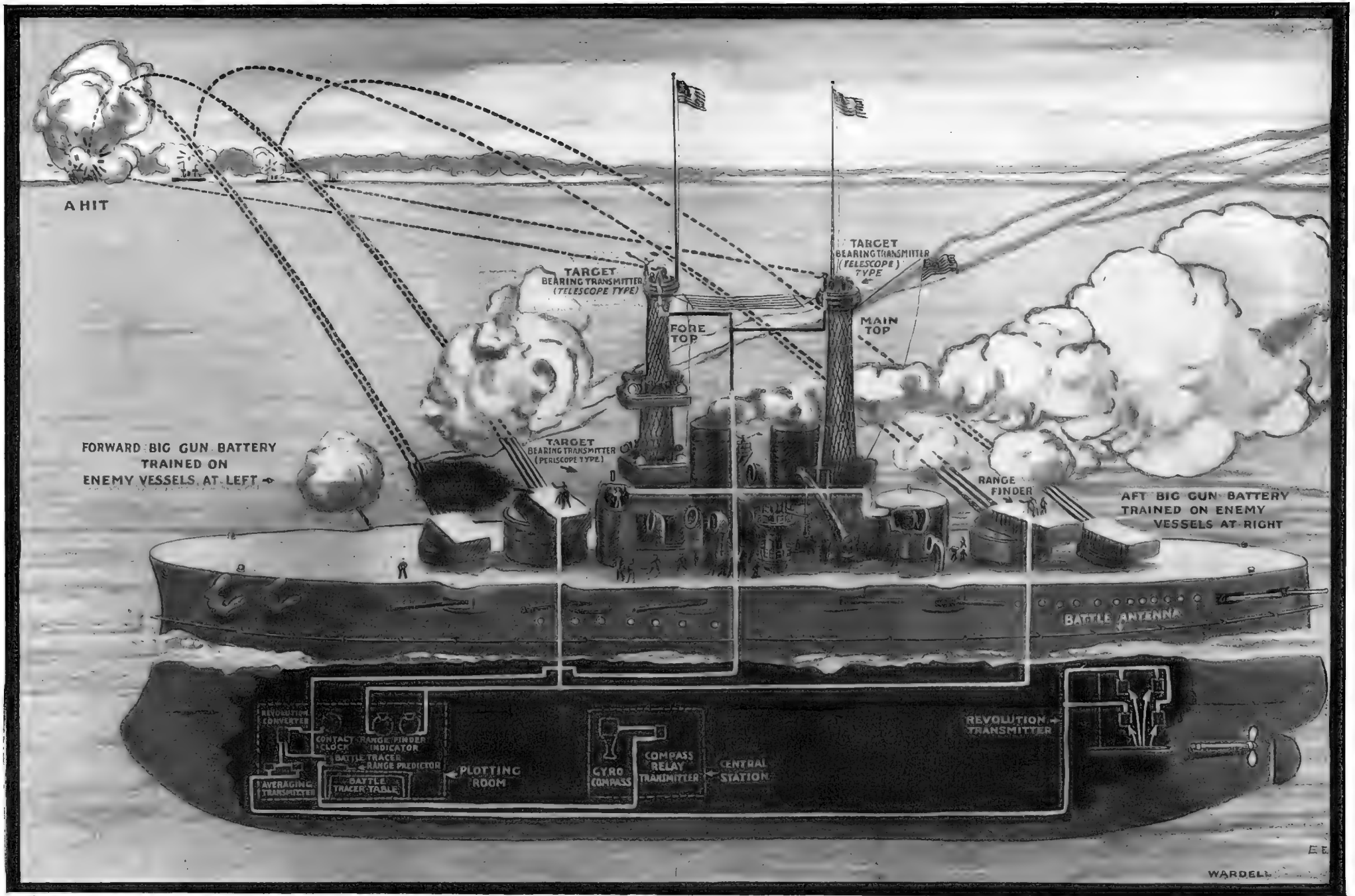
Essentially, the apparatus consists of a cylindrical box about 7 inches in diameter and 5½ inches deep, containing four motors, and necessary gearing. It is mounted upon a tracer table and guided by a system of parallel arms which allow free movement in any horizontal plane, at the same time, however, preventing the Tracer from turning on its axis. This allows the outer dial (A) of the Tracer to be kept in one position continually with reference to the table. (Accompanying letters refer to close-up view of Battle Tracer dials.)

This dial of which we have just spoken, is one of the three dials which perform varied functions. As will be noted, the outer dial is graduated to 360 degrees and is held on the table so that zero of the dial is north on the chart and is always at the upper edge of the table, altho capable of movement in any way except the turning movement.

Just inside of this dial and operating in juxtaposition with it, is another dial (B) similarly graduated but movable. This dial is controlled from the gyro-compass by one of the four motors inside the Battle Tracer head.

A pointer coming from the center of the Tracer head extends to the edge of this dial and the outline of a ship with its bow at zero is also engraved upon it. This pointer (D) which we have just spoken of is connected to the enemy arm and operates in conjunction with it, being moved by another motor connected to the Target Bearing Transmitters. Both the pointer and the enemy arm are capable of complete revolution. This movable dial (B) is mounted upon a movable post, to the bot-

(*Continued on page* 1332)



This Picture Diagram Shows the Location of the Wonderful Electric "Battle Tracer" Now Installed on Uncle Sam's Battle-ships and Which Was Used During the War. With This Device, Which is Always Installed Well Below the Water Line in a Secret Part of the Vessel, the Ship's Mighty Guns Can Be Trained Ahead of Time So As to Hit the Enemy with Great Accuracy, As He Rushes Thru the Water At 30 Knots Or More Per Hour, At Any Position from the Vessel Which Carries This Equipment. The "Battle Tracer" Proper Comprises a Motor-Actuated Arm, Fitted with a "Range Predictor," All of Which is Traversed Electro-Mechanically Over a Sheet of Paper Secured to the Top of the Battle Tracer Table. Connected with the Battle Tracer Are All of the Necessary Apparatus for Properly Coordinating the All Important Factors, Such As the Revolutions of the Ship's Screws or Propellers, the Direction of the Target As Recorded by the Men in the "Fighting Tops," Who Are Spotting the Enemy Thru the Telescopes of the "Target Bearing Transmitters," As Well As the Compass Bearings Transmitted to the Device from the Master Electric Gyroscopic Compass. The "Battle Tracer" Performs All of Its Functions in Exactly Nineteen Seconds, When It Is Possible to Telephone Directions to the Men Behind the Guns, Just Where to Aim to Hit the Enemy Ship At a Later Point In Her Course. She Might Ziz-Zag You Will Say and Fool the Battle Tracer and Range Predictor, But You Cannot Ziz-Zag a Ship 600 Feet Long, or Switch Her Course At 20 to 30 Knots an Hour, As You Would a Baby-Carriage,—and Thus the Battle Tracer Gets In its Deadly Work.

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Heat of Body Detected 600 Feet Away

ALTHO you do not know perhaps, or at least may not have stopt to think about it, one of Uncle Sam's military experts can spot you in the dark, and tell in what direction you are moving—and at a distance of 600 feet—all due to the fact that your body radiates HEAT! Not very much, it is true—but still enough to affect a sensitive electric thermopile of the type shown in the accompanying illustration.

A recent issue of the *Physical Review* contains a summary of a paper read by Mr. S. O. Hofman at the Washington meeting of the *American Physical Society* on this extremely interesting subject. In trench warfare operations on the Western front, maneuvers took place mainly in the night time, as any movement during the day quickly attracted hostile rifle and artillery fire.

An attempt was made, therefore, to detect the presence of men moving in "No-Man's-Land" at night by recording or indicating the heat radiated from their bodies. The receiver utilized a delicate heat-actuated instrument or heat indicator for this purpose, comprising an electric thermopile placed or mounted on the focus of a 14-inch parabolic mirror. This thermopile, which generates a very minute yet measurable electric current whenever a heat ray, even tho ever so slight, impinges on it, is connected to an extremely sensitive electric galvanometer or magnetic needle instrument of the D'Arsonval type.

Remarkable and uncanny as it may seem, it was actually found possible with this sensitive apparatus *to detect the presence of a man at a distance of* 600 *feet* or over one-eighth of a mile away, which gave plenty of time in most cases to organize a counter-attacking party, or extra guard.

This device proved very useful for detecting hostile raiding parties creeping towards the trenches in the darkness of night, and helped in many cases to capture some badly wanted enemy prisoners for the purpose of questioning by the intelligence officers, especially when an attack was about to be made by the Allied troops.

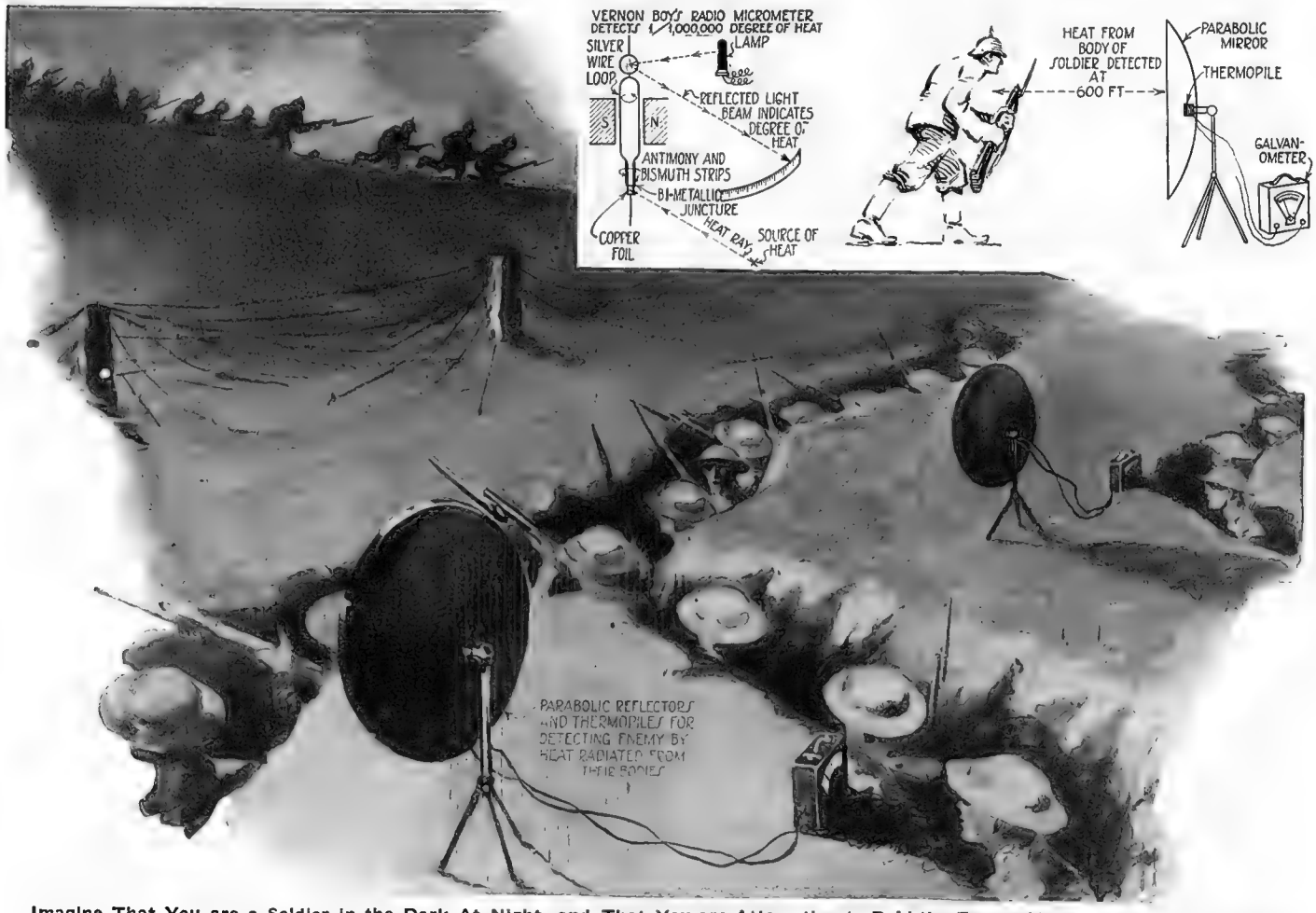
One of the accompanying illustrations shows an effective and sensitive form of thermopile. The minute electric current generated at the juncture of two dissimilar metals such as copper and iron, or antimony and bismuth, when heated by the impinging of a heat ray upon the juncture, will cause a deflection on a sensitive galvanometer connected to the opposite terminals of the thermopile.

Altho it is but little known, thermopiles so sensitive that they will record the heat radiated by distant stars have been devised and regularly employed in astromony work by those engaged in this work.

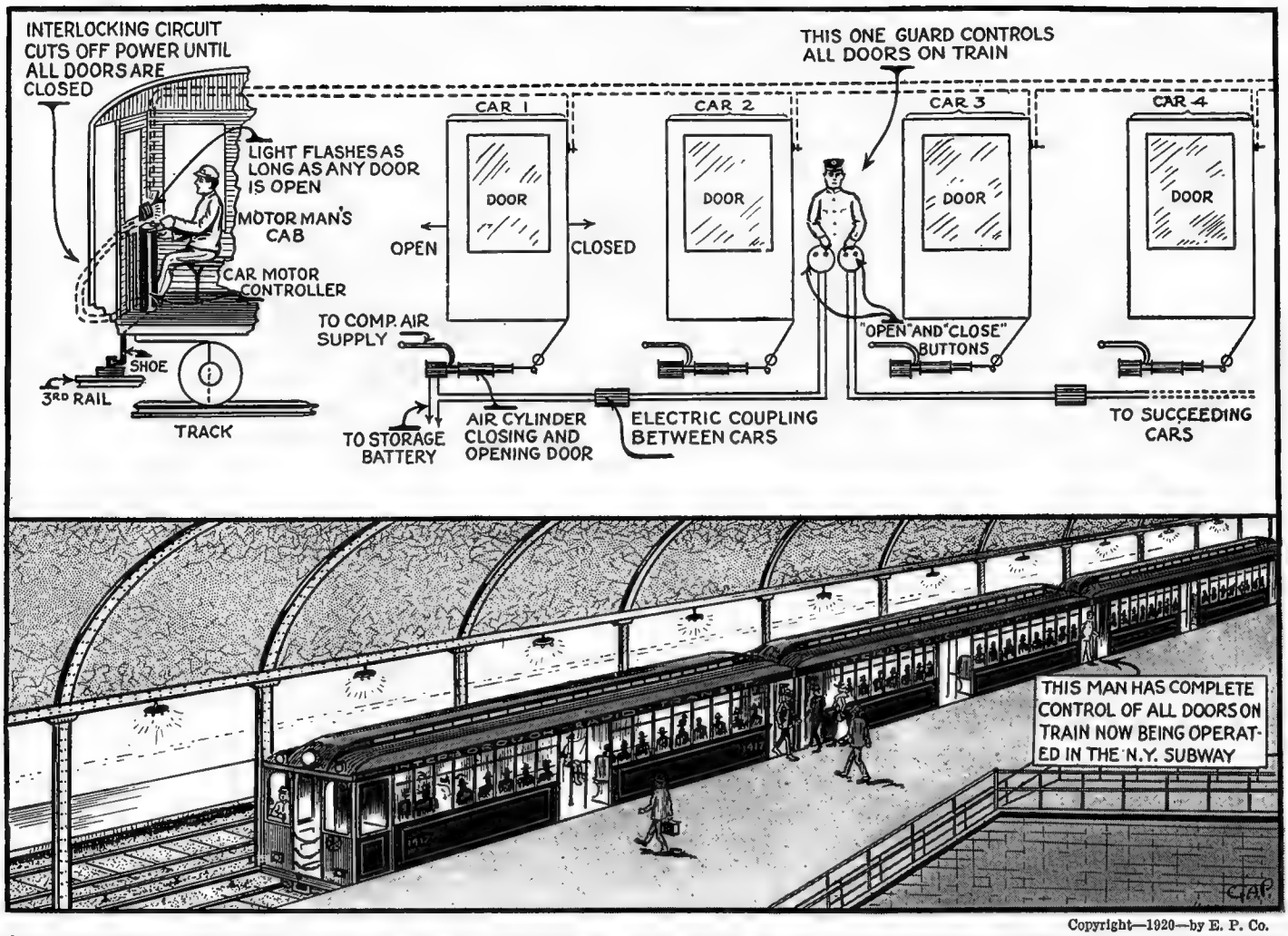
Dr. W. W. Coblentz, of the U. S. Bureau of Standards, has devised an extremely sensitive thermopile for this work, and this is built in an evacuated glass tube. On this measuring instrument are registered infinitesimal fluctuations of temperature.

A ray of light may have started ten years ago from some distant star, and may have spent all of these ten years hurtling earthward-bound thru space at a speed so astounding that it could girdle the globe in far less time than it takes to blink an eye—and yet when it falls upon the bolometers at the Bureau of Standards they will tell the observer how much heat that ray brought with it from the star to the earth!

As Silvanus Thompson points out, one of the most remarkable instruments of this type is the radio-micrometer devised by Vernon Boys. On this instrument a loop of fine silver wire is suspended by a quartz fiber between the poles of a magnet, and this loop of silver wire has its circuit closed at its lower end by a piece of antimony and a piece of bismuth (or alloys of these metals) soldered to a minute disc of copper foil. A rise of temperature in the copper foil, *even so small as one-millionth of a heat degree,* will generate an electric current in the loop and give a deflection over one division of the scale on the instrument. With a heat detecting instrument of this type the radiant heat of a candle can be detected at a distance of two miles, as Silvanus Thompson shows.



Imagine That You are a Soldier in the Dark At Night, and That You are Attempting to Raid the Enemy Trench. Likewise, Imagine That You are At a Distance of Nearly One-quarter of a Mile from Said Trench. If It is Pitch Dark, You Will Feel Very Confident in the Dark, That You Can Sneak Up On the Enemy Without Exciting the Least Suspicion On His Part,—But Foiled Again!—for It Now Develops, That the Electrical Experts of the Allied Military Engineers Had Developed and Utilized a Super-sensitive Electric Thermopile, Which Will Detect the Heat Radiated from the Human Body, At a Distance of from 600 to 1,000 Feet, and Many a Dead German Soldier Would Tell You the Answer, If He Could!


INTERLOCKING CIRCUIT CUTS OFF POWER UNTIL ALL DOORS ARE CLOSED
LIGHT FLASHES AS LONG AS ANY DOOR IS OPEN
MOTOR MAN'S CAB
CAR MOTOR CONTROLLER
SHOE
3RD RAIL
TRACK
TO COMP. AIR SUPPLY
TO STORAGE BATTERY
AIR CYLINDER CLOSING AND OPENING DOOR
ELECTRIC COUPLING BETWEEN CARS
THIS ONE GUARD CONTROLS ALL DOORS ON TRAIN
CAR 1
CAR 2
CAR 3
CAR 4
DOOR
OPEN
CLOSED
"OPEN" AND "CLOSE" BUTTONS
TO SUCCEEDING CARS
THIS MAN HAS COMPLETE CONTROL OF ALL DOORS ON TRAIN NOW BEING OPERATED IN THE N.Y. SUBWAY

Copyright—1920—by E. P. Co.

One Man Controls All the Doors on This New Semi-Automatic Subway Train Now Being Tried Out In Actual Practise in the New York Subway. As the Diagram Shows, the Guard Stationed at the Center of the Train Can, by Pushing the Proper Electric Control Buttons, Cause Electro-Magnets to Control the Comprest Air Mechanism Opening and Closing the Successive Car Doors. The Motorman Can Start the Train Only When All the Doors Are Closed.

One-Man Subway Train

A TRAIN comes dashing into a subway station, stops, discharges its passengers and allows others to enter. There is nothing unnatural in this "train" of events, as hundreds of trains come tearing in and out of the stations in New York's subways every day in the year. You go to ascertain from the guard where the nearest station to somewhere is, and travel to the end of the car,—but no guard in sight! With a shrug of your shoulders and the thought "Hmmmm-m! Perhaps he is down the next car playing cards with his comrade," you travel thru another coach but still no guard, and so on down the 10 car train until you wonder whether you are paying for a ride or walking the distance, and then,—at last! *a guard!!*—right in the *middle* of the train.

After finding out that it takes exactly six blocks to the left and two to the north, with a couple of turns in the opposite direction thrown in, to get to the desired place, you stick around awhile, so to speak, in order to find out why but one guard is in the entire train. Cutting down expenses? Rather. Here in the middle car, his Imperial Majesty—"the Guard"—has control of the entire train and can aim the doors so that they will just miss you by a hair even tho he is two-hundred feet away from the door you enter.

In other words, by the press of a button, all doors on all cars either close or open at his volition. And months of experience has taught him exactly when to release the doors so that they will "clean up" everything in sight. The method of operation is very ingenious. Everyone living in the greater metropolis knows that the terminals of the subway have constantly sufficient guards to successfully jam in all the people a train will hold and shut the doors after them, so that they won't fall out again! Hence there is no necessity of having as many guards on the train proper as the company is now employing.

For this reason, they have stationed a guard in the center of this new semi-automatic train, so that he can command a view of both sides, by peeking out between the cars. At his right and left side are a series of push buttons for controlling electrically, all the comprest air operated doors either to the fore or aft parts of the train. When he presses a button, a series of solenoids automatically actuate the valves, allowing for the escape of comprest air from the cylinders operating the doors. The door is released and flies back, allowing the passengers of the train to be discharged. When other passengers have entered, he releases one button which shuts all the doors, from his position, up to the position of the motorman in the first car. He then actuates the button for performing the same function in the doors to the rear.

The instant all the doors are closed, an automatic control allows the motorman to throw his controller into the starting position which could not have been done before this. Likewise the signal light still lit while the door is open, is turned off automatically, and the light no longer flashes up toward the motorman, and interfering in this way, with his control.

Any of the doors may be instantly placed into an inoperative position, just the same as is being done at the present time, and very little change in the old cars, is necessary for adopting the new system.

Storage batteries are used to actuate all the electrical controls. Such apparatus, if put into universal use on all trains, would dispense with from 12 to 15 guards per train, who could do abler service perhaps, on the platforms of the subway stations.

Notice to Readers

In view of the fact that we are still handicapped due to the recent printers' strike, we have as yet not been able to catch up with our schedule. We would therefore ask our readers to be patient and not write us about the lateness of the issue for the next three months.

With the June issue we expect to catch up again with our regular schedule. In other words, the June issue will be out about May 25th. Several other publishers found it necessary to skip an issue in order to come up to date, but we prefer not to do this. We hope our readers will understand and bear with us until we are back to our former schedule again.

THE PUBLISHERS.

Watching Plants Grow

Remarkably Sensitive Instrument Devised by Sir Jagadis Bose of India

IF you have ever planted flowers or vegetables and watched them grow from day to day, and from week to week, you have undoubtedly been strongly imprest with the remarkable changes which sometimes occur in a single night in plant growth. But—did you ever notice the change in growth of a plant or flower in the course of an hour, or a minute, or a *second?* Quite possibly not—but if you are interested in the close laboratory study of plant growth, then it is possible today to make readily visible the minute growth of plant life, even over such short periods of time as one one-hundredth of a second.

While there are a number of very interesting and useful devices available in college laboratories for the study of plant growth, as well as the action and reaction of plants, due to the application of heat and cold, as well as various chemicals and electric shocks administered at different time intervals, et cetera, one of the most accurate and remarkable instruments ever devised for this study is the one recently used by Sir Jagadis Chandra Bose, hailed as the most eminent man of science that modern India has produced, and which device is known as the *Crescograph.* This instrument is shown in the illustration on our front cover, as well as in one of the accompanying drawings by our artist.

HOW THE "CRESCOGRAPH" MAKES PLANT GROWTH VISIBLE.

Before going into the details of the *crescograph* or the *auxanometer,* both of which show the growth of plants in a vivid manner, it will be interesting to note what a really wonderful magnification of minute movements of the plant the crescograph actually gives.

Recently a large audience seated in the council chamber of the India Office, in London, England, *watched the growth of a plant* and the effects of various stimulants upon it, as recorded upon the large screen on the wall. This was at a lecture given by Prof. Bose. Either sunlight or else a beam of light from a small incandescent lamp may be used in the crescograph, and this light beam is reflected thru a series of mirrors in the manner evident from the accompanying illustration, so that by the time it reaches the screen the relative movement between the mirror and the focal spot of the impinging light beam is very markedly magnified.

In the case of the lecture just cited, a magnification of from 1,000,000 to 100,000,000 times was achieved. This is tantamount to magnifying the highest powers of the microscope 100,000 times. The room being darkened, a mysterious *hook of light* past swiftly over the screen. This showed the actual growth of the plant as projected from the mirror of the crescograph, magnified many hundred thousand times. The lecturer pointed out that this hook of light illustrated the effect of electricity upon the plant—too great power having the opposite effect to the stimulation afforded by a reasonable amount.

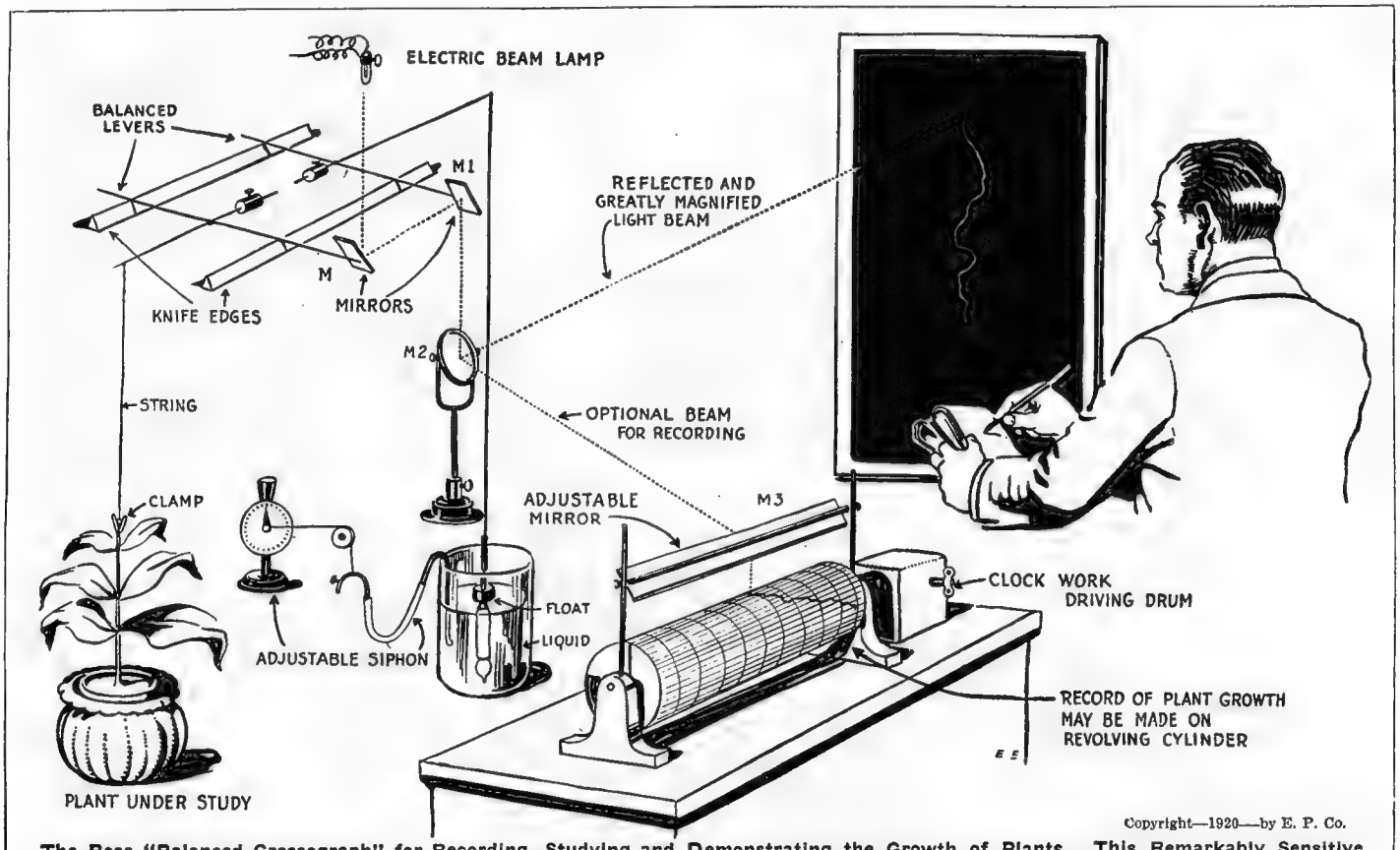
One of the chief features and applications of such an instrument as this, as pointed out by Prof. Bose, is the much shorter time that it would now require to obtain a definite knowledge of the growth of a certain plant under specific soil and climatic conditions. Instead of watching a whole season to learn if a certain plant will grow well in a given soil, and in a given climate, this test can now be carried out in a few days or weeks. The accompanying graphic curves show some of the effects of electric shocks and poisons on plant growth.

HOW FAST DO PLANTS GROW?

Altho you probably think a plant grows at a fairly rapid rate, even tho you cannot notice it in a period of, say, five minutes or even an hour, yet the plant really grows much more slowly than you perhaps imagine.

The little snail, whose slowness is proverbial, moves 6,000 times faster than the plant grows! Plants grow at an average rate of one one-hundred thousandth part of an inch per second, or, in other words, *plants add about one inch to their stature in eleven days.* A few years ago you would have thought it impossible to actually see the plant grow before your eyes, but now, thanks to Dr. Bose's remarkable researches, you can readily do this with the *crescograph.*

At a recent London lecture, Sir Jagadis Bose took a cyclamen leaf and attached it to the crescograph. The mirror at once reflected a spot of light on the wall screen, and this spot moved at the rate of ten feet in twelve seconds, notwithstanding the fact that the plant was growing only at the



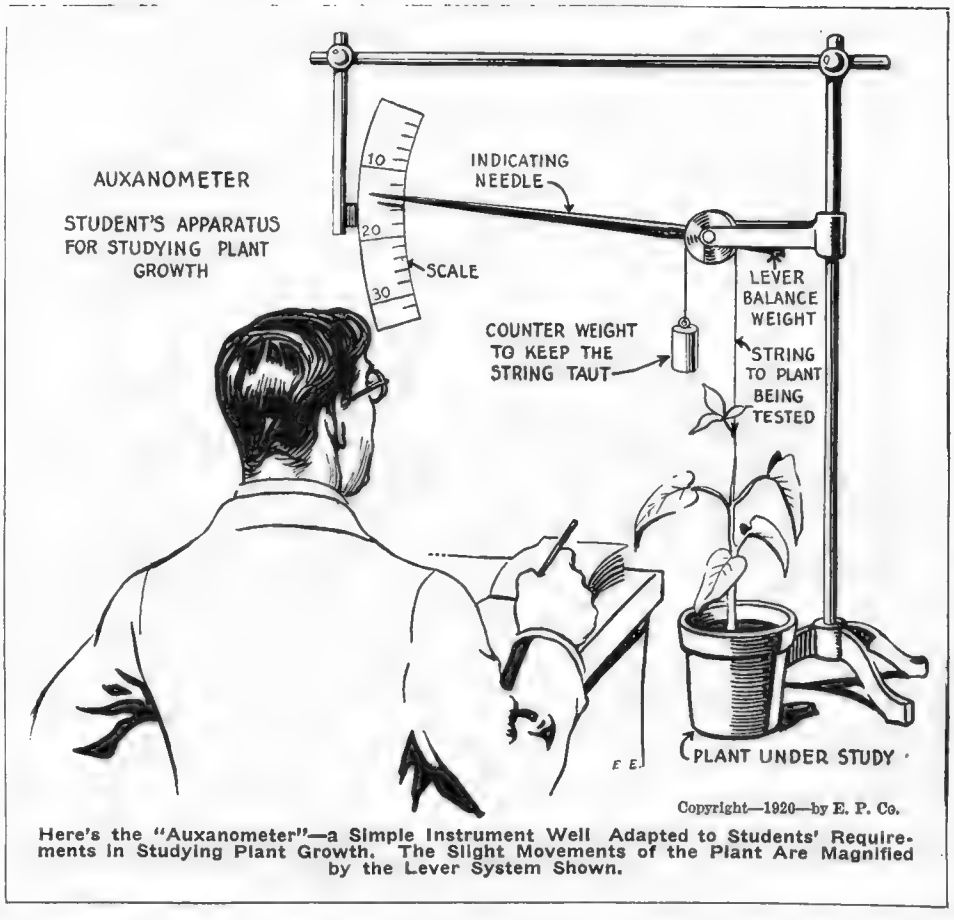
Copyright—1920—by E. P. Co.

The Bose "Balanced Crescograph" for Recording, Studying and Demonstrating the Growth of Plants. This Remarkably Sensitive Instrument Magnifies the Movement of a Plant While Growing, Up to 100 Million Times. In London, Recently, a Whole Audience Witnest the Action of Plants as Reflected on a Large Lecture Screen.

actual rate of 1/100,000th part of an inch per second.

Plants resemble animals very much in their daily lives, and Dr. Bose's researches have shown the presence of heart beats, death spasms, definite and positive reactions to various forms of stimuli, to anesthetics, poisons, etc. All of this work shows, according to Prof. Bose, that plants, like human beings, do have a nervous system. It is reported that this great savant of Indian culture and science has actually shown that plants can and do feel the effect of an etheric wave message, or a Marconigram, as they pass over the earth. This proves that the plant is more sensitive in its nervous response than the human body, which we usually are wont to think of as the most marvelous structure ever created. People have never yet, so far as we know, been able to "feel" a wireless signal or wave passing thru them, but by means of specially sensitive apparatus connected to a plant Prof. Bose has shown that the plant really feels the effect of the radio wave and will interpret this effect under the proper conditions.

One of the interesting stories of Prof. Bose's interesting work relates how he studied a certain tree in India which had never been *transplanted* successfully. He reasoned that the tree died when transplanted because of the severe shock it received when it was dug from the ground, so he followed up this deduction by having a tree subjected to an *anesthetic*, in the same manner that the modern surgeon causes his patient to become unconscious in preparation for a surgical operation. Strange to relate, the tree manifested the same characteristics as a person under an anesthetic, and it was successfully transplanted while under the effect of the same. The tree continued to thrive.



Here's the "Auxanometer"—a Simple Instrument Well Adapted to Students' Requirements in Studying Plant Growth. The Slight Movements of the Plant Are Magnified by the Lever System Shown.

HOW THE CRESCOGRAPH WORKS.

Several different forms of magnifying instruments for studying plant growth have been devised by Prof. Bose, and by other workers in this field of science. The standard form of Bose's crescograph is shown diagrammatically and in picture herewith. The student will find the simple form of plant growth measuring instrument, known as the *auxanometer*, illustrated herewith, quite within his mechanical possibilities, and it can be made up in many different ways. A smoked glass caused to travel slowly past the needle of such an instrument will record the changes taking place.

One principle, and in fact the underlying feature of all these instruments, appears to be the fact that a slight movement is magnified into a larger movement, by the well known law of levers—thus if you have a lever 100 inches long, and place a fulcrum at one inch from a given end, then any movement at the end of the shorter or one inch length of the lever will cause a corresponding and greatly magnified motion of this lever at the free end of the longer limb, which will be 99 times the initial movement.

The reader can readily devise a simple form of magnifying apparatus constructed from some pieces of aluminum wire and possibly a balance wheel, with its supporting pivots cut from an old alarm clock frame, whereby he can obtain some interesting results in watching the growth of plants.

There are two forms of the crescograph, the *simple crescograph* and the *balanced* type. The larger illustration herewith shows the details of the balanced crescograph devised by Prof. Bose. The principle involved in the method of balance consists in making the spot of light, which is moving in response to growth, become stationary by subjecting it to a compensating movement.

Let us suppose the average rate of growth to be 1.2 mm. per hour. This will cause an excursion of the moving spot of light from, say, left to right, thru 1,200 mm. by the end of the hour; in that case the magnification is 1,000. Had the growth been uniform this would have meant a movement of 20 mm. per minute. But if not uniform the rate might sometimes have risen above, and at other times fallen below, this average. If we now subject the spot of light to a uniform compensating movement, such as by itself would have made it move from right to left of the recording surface to the extent of 1,200 mm. by the end of the hour, we shall find that, being acted on by these two opposite movements of growth and compensation, the spot will remain approximately on a single base line of compensation. The fluctuations, or variations, which have occurred in this average rate of growth will, however, be recorded as deviations to one side or other of this mean neutral line. Thus it will be seen that the slightest deviation from a uniform rate of growth will be found displayed by the record of the moving spot of light.

We are further enabled from our knowledge of the speed of the recording drum and the balancing rate, and from an inspection of the curve itself, to determine not only the periodicities, but also the absolute value of the rate of variation of growth at any given moment.

The compensating movement referred to is effected by means of a simple hydraulic device. The spot of light from the optical level falls upon a mirror attached to a second lever, or to a rotating wheel. The arm of the lever, or a thread which is past around the wheel, is attached to a float on the surface of a cylinder of water. Water is escaping from this cylinder, by means of a syphon arrangement, at a rate which can be adjusted with the greatest nicety. The float can be thus made to descend at any speed that is desired, this descent producing a rotation of the second lever or of the wheel.

We have then two mirrors, of which one is rotated in one direction, by the *growth-movement* of the plant, and the second in in the opposite direction, by the *descent of the float*. A spot of light reflected on the two mirrors will thus remain *stationary* when the precise balance is effected by proper regulation of the escape of water from the cylinder (see our figure herewith).

(*Continued on page* 1318)

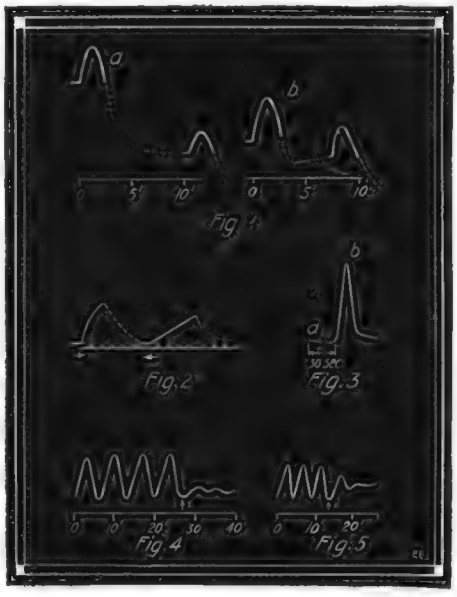


Fig. 1. Fatigue Under Long-Continued Stimulation in the Contractile Response of Plants. (a) Stimulation by Tetanizing Electric Shocks: (b) Stimulation by Rapidly Succeeding Thermal Shocks.

Fig. 2. Effect in Acceleration of Rate of Growth of Seedling of "Oryza Sativa" of Current Thru the Soil. The Continuous Line Shows Effect During Passage of Current Thru the Soil (1) from Left to Right (→), and (2) from Right to Left (←). Dotted Line Shows Effect of Cessation of Current.

Fig. 3. Additive Effect in Electrical Response of Plants. (a) A Single Stimulus of 3 Degrees Vibration Produced Little or No Effect, but the Same Stimulus When Rapidly Superposed Thirty Times Produced the Large Effect (b). Leaf Stalk of "Turnip."

Fig. 4. Death of Plant by Poison.

Fig. 5. Death, and Arrest of Pulsation, in Leaflet of "Desmodium," by Electric Shock.

Hello Mars!

By H. WINFIELD SECOR

Shall We Ever Be Able to Signal Mars Intelligently?

IN the past ten years, and particularly in the last twelvemonth, there has been evidenced a great deal of activity on the part of scientists in all parts of the world, on the subject of communicating with Mars, or possibly Venus. The present discussion has nothing to do with the astronomical facts of the case, for these are already well known,—at least so far as the distance between the Earth and Mars is concerned, and other heavenly bodies.

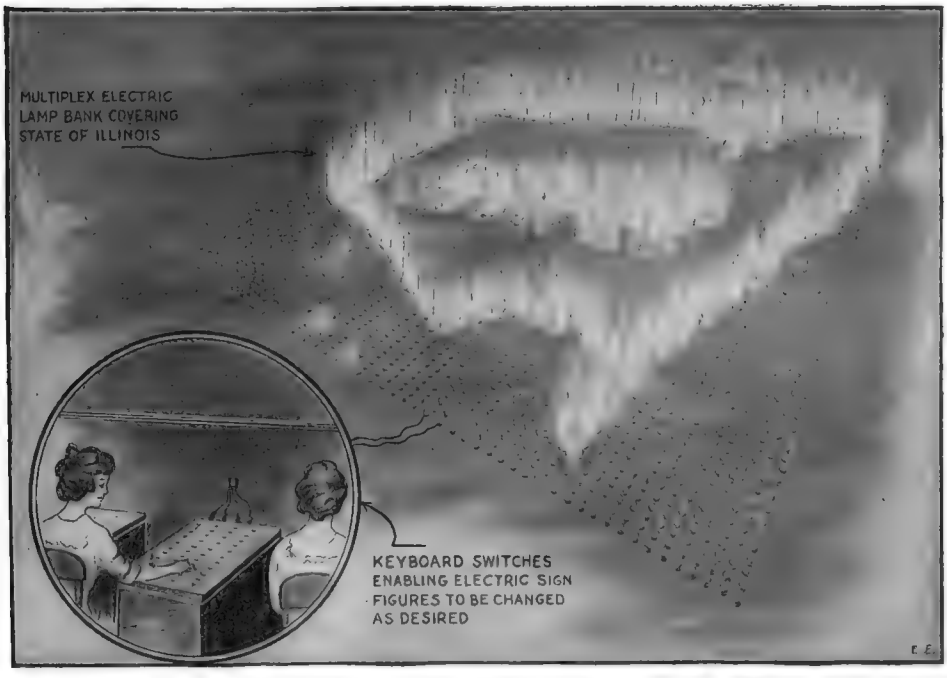


Fig. 7. One Writer on the Subject of Inter-Mars Communication Has Suggested That We Place Lamps, Thousands Upon Thousands of Them, Over a Large Territory—as Big as the State of Illinois—These Lamps To Be Fitted with Quick-Acting Shutters, Electrically Operated. The Lamps Are Also To Be Connected to Suitable Keyboards so That by Depressing a Given Pattern of Keys, Any Design Such as a "Map" of the United States, with the Letters "U-N-I-T-E-D S-T-A-T-E-S" Illuminated Can Be Flashed Out of the Entire Lamp Field as Here Shown, etc. Any Desired Letter or Picture Could Be Flashed on This Multiple Lamp Bank, as Becomes Evident.

The main thing that we do not know about Mars, is whether or not it is inhabited, but we will leave all of the vast and profound theories on the possibility of Mars' inhabitation, to the astronomers and others who are capable of investigating these facts.

So far as we are concerned in the present instance, we will assume that there is such a being as a "Martian". Next, the all-important and preponderant phase of the Mars' inhabitation theory is—how, and in what way could we start picking up conversation or communication with our distant neighbors, intelligently.

It seems quite evident, that once we have outlined and developed the proper method of procedure to start transmitting and possibly interpreting the Martian signals, as well as making sure that our method is correct, that the Martian may, with his supposedly far greater intellectual development, (owing to the greater age of Mars as compared with the Earth,) understand what we are trying to say to him.

It is nothing short of startling to read some of the newspaper details that come from all parts of the world, suggesting the "simple schemes" whereby we can open up communication with a people of whom we know absolutely nothing about. Think of it! Aside from the fact that we have to doubt their very existence, we do not have the slightest conception of what they look like, nor what their language may be!

One of the latest Martian communication converts is Dr. Charles Proteus Steinmetz, probably the world's greatest electrical engineer today, and one of our foremost mathematicians. If anyone should be able to conceive of a scheme for opening up conversation by wireless telephone or telegraph, or other means, with a strange neighbor so distant as the Martians, Dr. Steinmetz should certainly be fully qualified.

Dr. Steinmetz, in a recent statement, said that wireless communication with Mars is not at all improbable, and he suggested that signals might be transmitted by radio from a gigantic wireless plant on the Earth, which would be charged with all the electric power generated in the United States. This could be accomplished for the tidy little sum of about one billion dollars, according to Dr. Steinmetz, and would require steel towers at least 1,000 feet in height, in order to transmit radio messages or signals to the planet Mars,—which never comes any nearer the Earth than 35,000,000 miles, and at certain periods is 230,000,000 miles away. After mentioning the fact that we might accomplish the interpretation, after several years' recording, of the stray wireless signals mentioned by Marconi and Tesla as being picked up in their powerful radio stations, he goes on to say,—"If Mars was trying to communicate with this world, it is doubtful if it would ever be possible to decipher the code, but it would be some satisfaction to know that one planet could send messages to the other, and that intelligent beings were inhabiting the planet from which these messages came. We know enough about Mars to assume that there are inhabitants there," said Dr. Steinmetz, "and as it is a much older planet than ours, its inhabitants ought to be more advanced in scientific and educational investigations."

But—"*It is doubtful if it would ever be possible to decipher the code . . .* "—read that line over!—for it means a whole book-ful when you start to really think about it.

A SIMPLE EARTH-MARS CODE FOR NUMERICS.

There is, perhaps, no use of talking about communicating with Mars, or as we said before, with a people of whom we know absolutely nothing, but for the present we will consider that they are duly existing, and that they are, as some of our leading scientists and astronomers have argued,

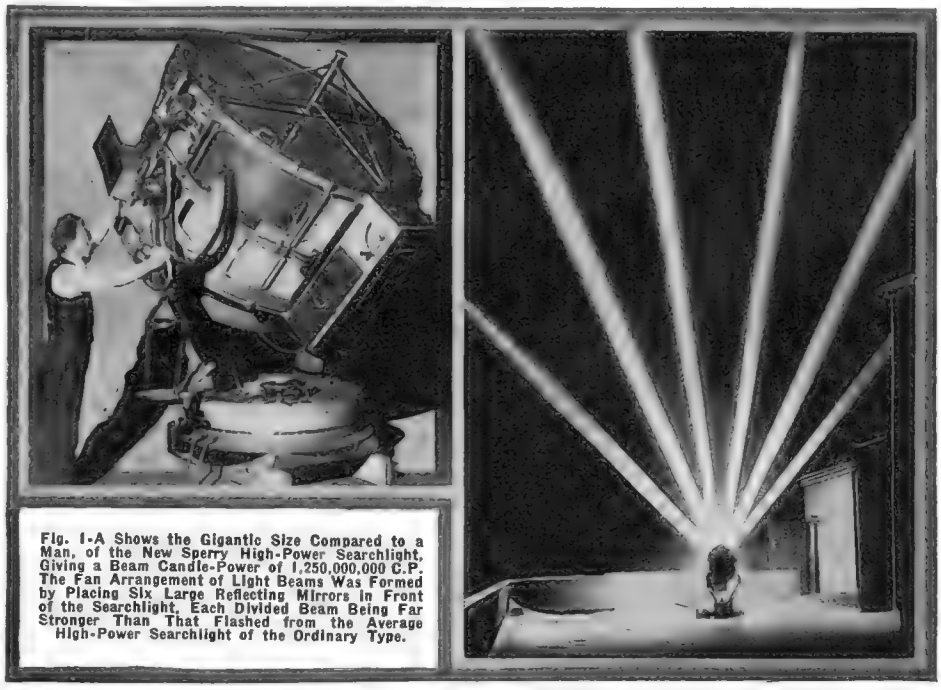


Fig. 1-A Shows the Gigantic Size Compared to a Man, of the New Sperry High-Power Searchlight, Giving a Beam Candle-Power of 1,250,000,000 C.P. The Fan Arrangement of Light Beams Was Formed by Placing Six Large Reflecting Mirrors in Front of the Searchlight. Each Divided Beam Being Far Stronger Than That Flashed from the Average High-Power Searchlight of the Ordinary Type.

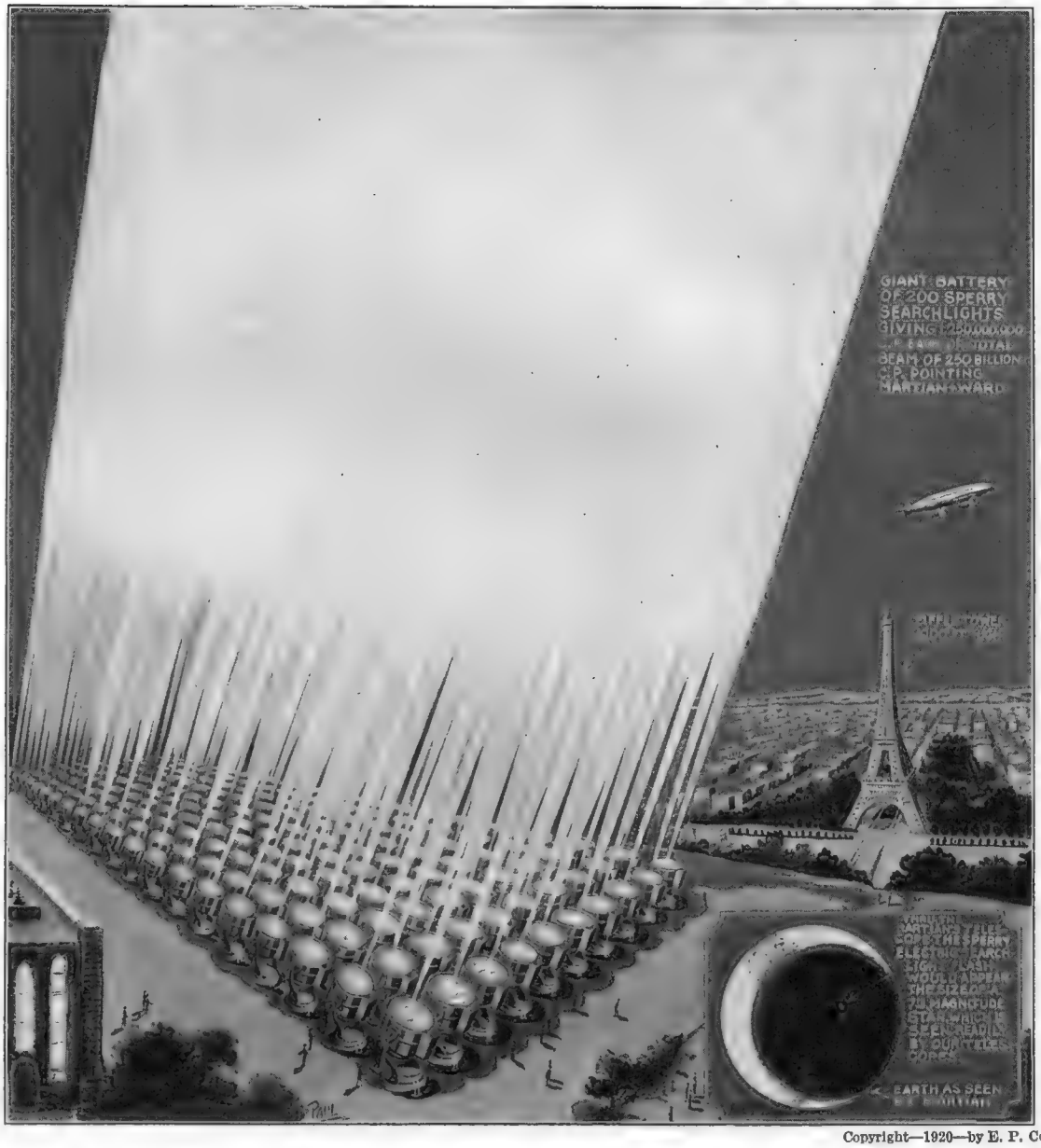

GIANT BATTERY OF 200 SPERRY SEARCHLIGHTS GIVING 250,000,000 C.P. EACH, OR A TOTAL BEAM OF 250 BILLION C.P. POINTING MARTIAN-WARD
EARTH AS SEEN BY MARTIANS

Fig. 1. The Latest Proposal as to How to Signal the Inhabitants of Mars Is That of Mr. Elmer G. Sperry, Inventor of the World's Most Powerful Electric Searchlight, Shown at Fig. 1-A. Mr. Sperry Proposes That We Employ a Battery of 200 of His 1,250,000,000 C.P. Searchlights in One Gigantic Bank, so as to Concentrate Their Rays in One Powerful Beam of Light. It Is Calculated That the Martians, If Such There Be, Cannot Miss This Blinding Flash of Light, Which Would Appear to Them as a Star of the 7th Magnitude, Which Is Easily Picked Up by Our Earthly Telescopes. This Beam of Light, Totaling 250,000,000,000 Candle-Power, Would Rival the Sun Itself.

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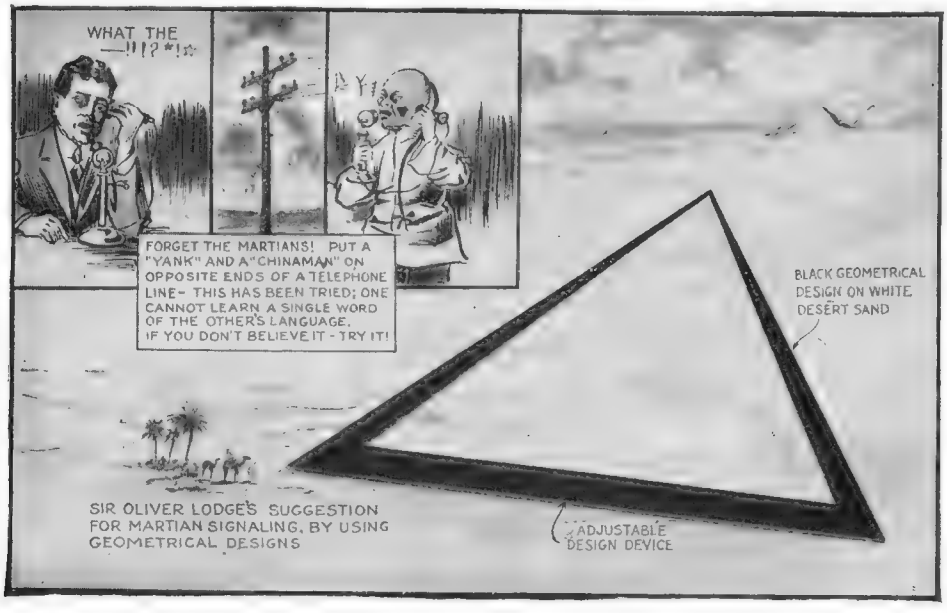
thousands of years in advance of us when it comes down to scientific matters including the languages. Probably they have but one language on the order of our rapidly growing universal language—*Esperanto*.

All well and good, but without wasting any more time conjecturing on the ways and means of interplanetary communication, let us start with the fundamentals of the understanding between any two Earthly human beings. To do this, as one professor of languages recently suggested to the writer, we certainly will have to step back to the period when we were little children. Go straight back to the days of the kindergarten, and then we are ready to start learning the real fundamentals of communication and understanding via the language route between humans. But before going further, we might take a glance at Fig. 2, which shows the simplest scheme for teaching or endeavoring to communicate to another person, the elements of numeric computation.

Fig. 2 shows that two dots, plus two dots, equal four dots. Little children are often taught in this way by several different schemes, how to count. Some of our ablest scientists and astronomers have suggested times beyond number, that this is a very good and plausible way to start communicating with the Martians, and not only this, but they often carry this idea to the point where it is claimed that eventually languages or codes explaining the languages may be transmitted and interpreted either by us or by the Martians.


WHAT THE —!!?*!☆
FORGET THE MARTIANS! PUT A "YANK" AND A "CHINAMAN" ON OPPOSITE ENDS OF A TELEPHONE LINE- THIS HAS BEEN TRIED; ONE CANNOT LEARN A SINGLE WORD OF THE OTHER'S LANGUAGE. IF YOU DON'T BELIEVE IT - TRY IT!
BLACK GEOMETRICAL DESIGN ON WHITE DESERT SAND
SIR OLIVER LODGE'S SUGGESTION FOR MARTIAN SIGNALING, BY USING GEOMETRICAL DESIGNS
ADJUSTABLE DESIGN DEVICE

It takes but a little reflection to see that, while presumably and with average intelligence no greater than ours, in a short time a person who doesn't know our language at all, should be able to perceive if shown a blackboard with this arrangement of dots, that we were trying to impress upon him the fact that two dots, plus two dots, equal four dots. Well and good, but when it comes to communicating letters or words of a language by this method, it would seem to be quite impossible, and altho the writer has discust this scheme with several experts on languages, they have not been able to think of a single method whereby it could be carried out.

Fig. 5 (Inset). You Do Not Have to Endeavor to Open Up Wireless Telephone Communication with the "Martians" in Order to at Once Perceive That You Have "Started Something"—so Far as it Is Possible to "Talk," or for That Matter if It Would Ever Be Possible for You to Learn Even One Word of Martian. The Experiment of Placing a Chinaman and a Yankee on Opposite Ends of a Telephone Line Has Been Tried for a Considerable Time Period, and Neither One Could Assimilate or Interpret one Word of Each Other's Language, Altho They Talked Long and Often, Over the Telephone. Fig. 6. Sir Oliver Lodge Suggests That We Build Large Geometrical Figures in Black on the White Sands of the Sahara Desert, and He Believes That the Martians Will Understand It, as Geometry Is a Universal Study and Science.

So we go back once more to the little children in the kindergarten class. We will

And Wonder of Wonders!—Here is the Very High-Powered Marconi Radio Station at Which the Mysterious Dots and Dashes Filtered in from the Ether—and Furthermore These Signals Are Believed by the Great Marconi Himself to Quite Possibly Be "Signals of Inter-Communication" Hurled at Us Thru Millions and Millions of Miles of Interstellar Space, via Wireless, by the Martians. At Left We See the 100,000-Meter Wave Inductance. At Right the Wonderful Eleven-Stage Audion Amplifier, Magnifying the Signals 10,000,000 Fold.

leave numbers out of the question, because we cannot carry on a conversation very well with a set of figures,—or at least we will presume that this is not the case with the Martians. How is a child taught the letters of the alphabet and their final correlation into words,—and again,—the meaning of these words?

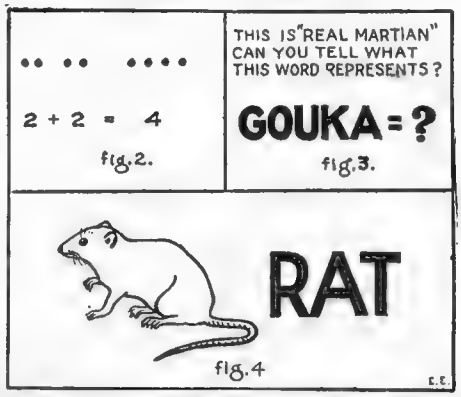
When you have thoroly philosiphized on this elemental detail of pedagogy, you at once become cognizant of the highly important fact that the little child who does not know anything about the language he is to be taught, cannot tell what such a simple word as "R-A-T" means. He can be taught the sounds of the letters of the alphabet so as to pronounce them—and also how to write them—but as soon as he has finished with this, think of asking him to define the word "rat"—a simple three-letter combination. Now, it is at once evident that the child has no more idea of what R-A-T means or stands for than the wood tie-post to which you hitch Old Dobbin—except for one potent and all-important consideration, and that is—that in the books from which he studies or else by means of the blackboard and the skilled artistry of the teacher, *he is shown a rat,* or possibly he might be shown a live one in a cage, or a dead one—but in any case he does two things when he first learns the meaning of any word, in this case "rat." He is first taught to pronounce and how to form the letters of the word in writing, and then he is shown simultaneously in some form the object which the word represents.

Some one may object at this point and say it is not so in every case that an object representing the word *is shown simultaneously* with the mastery of the word, but the answer is that if this is not done, then the teacher or the governess will have to launch forth on a lengthy *word-picture* explaining about the *rat,* let us say, and what it looks like.

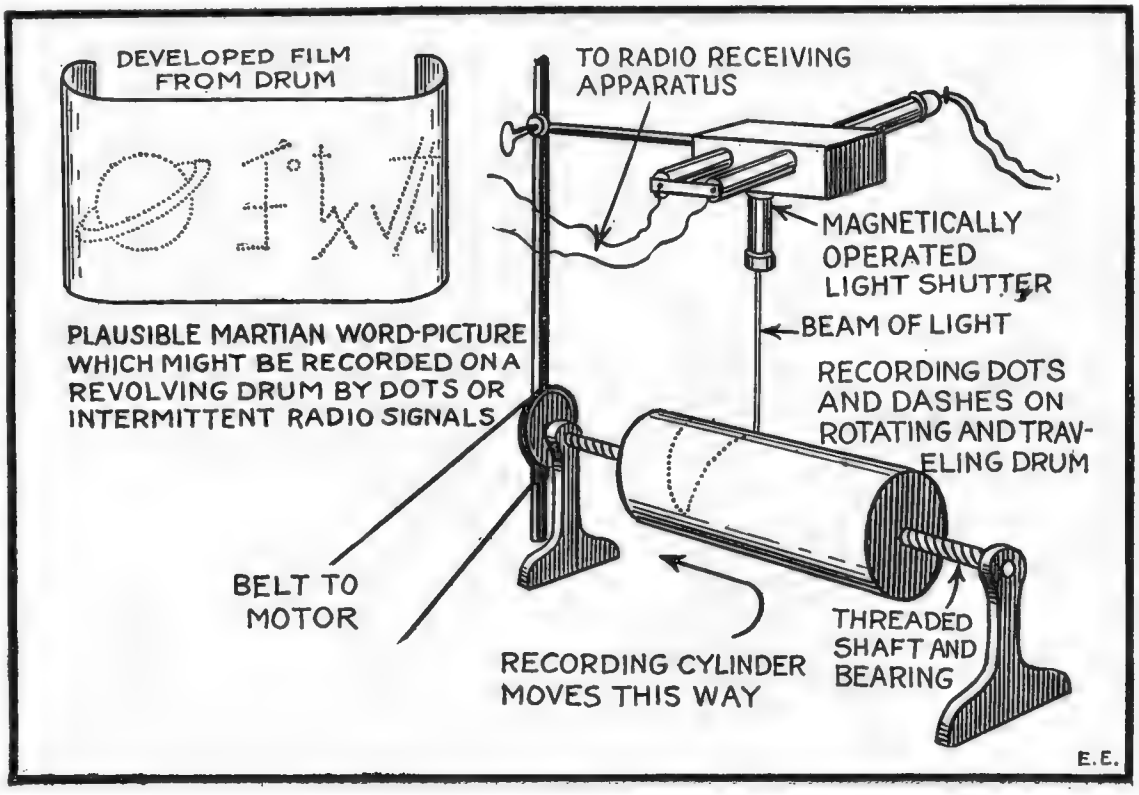
This basic element of learning any language is more forcefully shown at Fig. 3, where there is also shown what we shall call, for the sake of supposition, a real Martian word, G-O-U-K-A! Now just consider for one moment—no matter how familiar you may be with secret codes and ciphers—and try to think how you would look this *first Martian word* squarely in the face and endeavor to understand what object it represents! Does it represent a sea? Does it represent a house?—or a Martian horse?—or does it mean a declaration of war between two Martian nations—and so on and so forth.

Consider that the writer is a Martian and that thru your powerful earthly telescope some dark night you are confronted by a burst of light from Mars and upon directing your telescope more minutely and accurately towards this illuminated spot on the distant planet you read in outlines of fire this word. There is no use of taking any other words, for this one serves its purpose

(*Continued on page* 1302)



At Fig. 2 We Have the System—Commonly Advocated For Opening Up Communication Between the Earth and Mars by Means of Signals Sent by Light, Radio, etc. This Is to Give the Martian to Understand That We Earthians Count Two Dots Plus Two Dots as Four Dots. . It Is Conjectured That in a Short Time We Can Thus Inter-Communicate Very Nicely with Our Martian Neighbors. If You Think, However, That Such a System as This Will Eventually Lead to Inter-"Language" Communication and Understanding, Try and Dope Out What the (Assumed) Martian Word "G-O-U-K-A" Means. Fig. 3. In the Next Issue We Will Tell You. Fig. 4. The Most Logical Method of Establishing Any Inter-Language Communication with a Strange People, Such as the Martians, Surely Seems To Be by Means of "Word Pictures," Such as Shown Here, Flashed or Otherwise Transmitted Simultaneously, in Such a Manner That the Picture Can Be Built Up. Otherwise, if the Martian Received the Letters R-A-T by Radio and Could Understand Them, but Did not Know What Our Animal the "Rat" Looked Like—He Would Have Some Tall Difficulty in Trying to Find Out What R-A-T Meant, Granting, of Course, That He Knew Our Alphabet—For the Chances Are That Animal Life Is Different on Both Planets.


DEVELOPED FILM FROM DRUM
TO RADIO RECEIVING APPARATUS
MAGNETICALLY OPERATED LIGHT SHUTTER
BEAM OF LIGHT
PLAUSIBLE MARTIAN WORD-PICTURE WHICH MIGHT BE RECORDED ON A REVOLVING DRUM BY DOTS OR INTERMITTENT RADIO SIGNALS
RECORDING DOTS AND DASHES ON ROTATING AND TRAVELING DRUM
BELT TO MOTOR
RECORDING CYLINDER MOVES THIS WAY
THREADED SHAFT AND BEARING
E.E.

The Mysterious Stray Wireless Signals Which Have Been Recorded by the Marconi Trans-Atlantic Station, May Have Some Meaning Which We Do Not Understand as Yet. It Has Been Suggested by One Authority That Possibly if We Have the Proper Apparatus or Scientific Means For Interpreting These Apparently Meaningless Jumbles of Dots and Dashes, That We May Cause Them to Produce a "Picture." Suppose, For Example, That You Had a Revolving Drum Which Was Moved on Its Axis and Covered with a Photographic Paper or Film. If the Incoming Radio Dots and Dashes Were Recorded on This Drum, They Might Possibly Form a "Picture and a Word," Probably in Martian. If We Were Able to Obtain a Considerable Number of These Word Pictures We Could Eventually Figure Out What the Martian Alphabet Is. Fig. 8.

Electricity Foils German Seals

By FRED C. KELLY

HOW the Germans sealed up over a ton of official and secret papers in the safes of the Swiss Consulate at New York, only to be fooled by five American adventurers, who secretly opened the wax seals on the ropes and locks during the nights when the office was vacant proves highly interesting reading. The tale of these five doughty knights, whose names are unknown to the Government to this day, is told in this story. These unknown workers of Uncle Sam, who finally procured all the secret papers and handed them over to the Government, hired a suite of offices in the building where the papers were stored.

First they had their lock expert fashion a key to the outer door of the consular offices, and one night they went there to look the layout over. To all appearances the German papers were stored in two large safes, several sections of metal filing cases and a steel trunk.

Each safe and each filing case was bound around with rope and with red-white-and-black tape—in much the same manner that a shoe-box is tied with a piece of string at a store. The knots in the tape or rope were invariably covered with sealing wax of a special kind not easily imitated, and the wax was stamped with the official German seal.

Particular care had been given, apparently, to the sealing up of the larger safe. Pieces of sealing wax, bearing the official stamp, had been stuck at intervals all along the cracks at the edges of the safe doors. Official tape had been wound back and forth between the handles of the double doors of the safe, and the knots were sealed and stamped. The tape was also fastened against the flat surface of the safe doors with sealing wax and this, too, bore the official stamp.

Because the larger safe was the most carefully sealed up, the visitors assumed that it must contain the most valuable papers. They determined, therefore, to try to open that safe first of all. But even aside from the problem of working the combination, it looked like an impossibility to open the doors without disturbing the tape and seals.

In this way the seals could be removed one at a time, without disturbing the impression of the official stamp. Later the seals could be glued back to the same places from which they had been removed.

There was still the problem of getting the tape removed from the handles of the safe doors. But the callers hit on a plan for doing this that made the job simple.

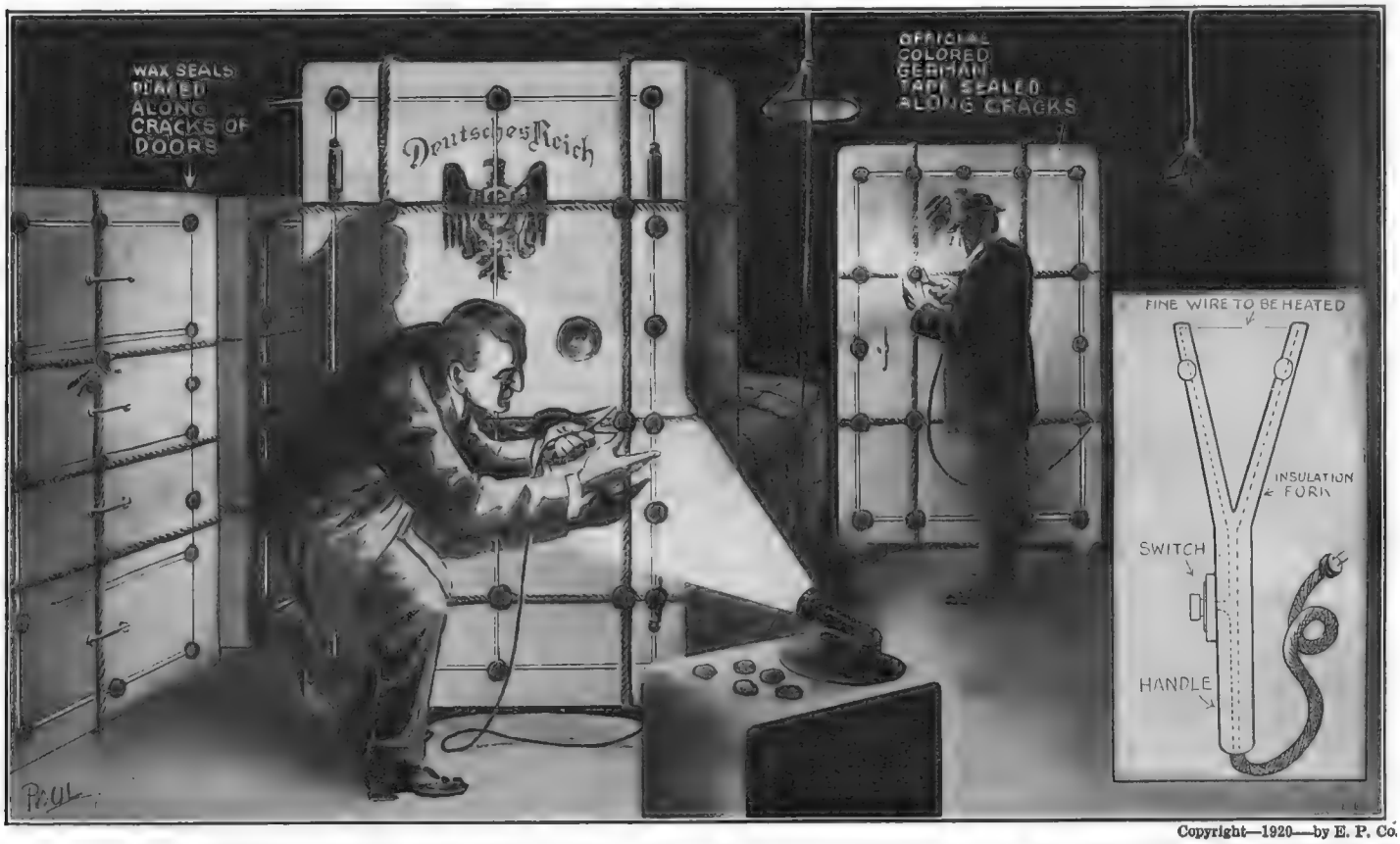
Instead of trying to remove the seals and unwind the tape, they removed the little invisible cotter-pin which held the grip part of each handle in place. Then the whole mass of tape could be slipt right over the knob of the handle. All very simple!

The handles showed slight blemishes where the pins had been removed, but this was quickly remedied simply by polishing the abrasion in the nickel-plating and applying a little nickel-plating solution.

The job of opening the safe, removing the contents and restoring the safe to its previous condition occupied the five men from about 11 o'clock at night until toward daylight. It was many days before they dared return to continue their search. While the nature of the papers in this safe was disappointing, the Germans, with typical German inefficiency, had left in the safe a great quantity of paper seals of exactly the same kind that they had used in sealing up the drawers of the metal filing cases. The possession of these seals greatly simplified the job of opening those drawers later on.

On a certain night while the Americans were at work on these files, a man, now supposed to have been the night watchman, came along and nearly stumbled upon them.

(*Continued on page* 1331)



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One of the Most Absorbing Chapters of "World War" History, Which Was Actually Enacted Not on the "Battle-Front"—But 4,000 Miles From It, in a Quiet Little Consulate Office Located in New York City, Is Here Told by the Author. The Germans, When They Left America, Placed Over a Ton of Valuable Papers in the Safes of the Swiss Consulate, and Plastered Up the Cracks of the Doors, and the Locks With Rope, Paper Tape, and Wax Seals Bearing the Imperial German Seal. Not to Excite Suspicion, Five Adventurous Americans Succeeded Finally, Thanks to the Clever Electric Heater Here Illustrated, in Removing the Seals Without Damaging Them—Procuring All the Secret and Valuable Papers—and Then Gluing the Seals Back Into Place.

HOW ELECTRICITY REMOVED GERMAN SEALS UNDAMAGED.

If these seals were noticeably marred it soon would be discovered that the safe had been tampered with. This would prevent later visits, and furthermore, if it became known that the papers were gone, part of the value they might have in tracing German agents might be lost.

The visitors saw that if they were to open the safe and not have their work afterward discovered they would need several ingenious tools. When they returned a few nights later they were equipt with such tools and devices as were required. The most noteworthy of these was an *electrical contrivance* which could be attached to one of the electric light sockets near the safe. The working part of this consisted of a Y-shaped instrument between the two prongs of which was stretched a fine wire. This wire, when heated by the electrical current, could be past underneath the seals where they adhered to the flat surface of the safe.

THE PHYSIOPHONE

Music For The Deaf

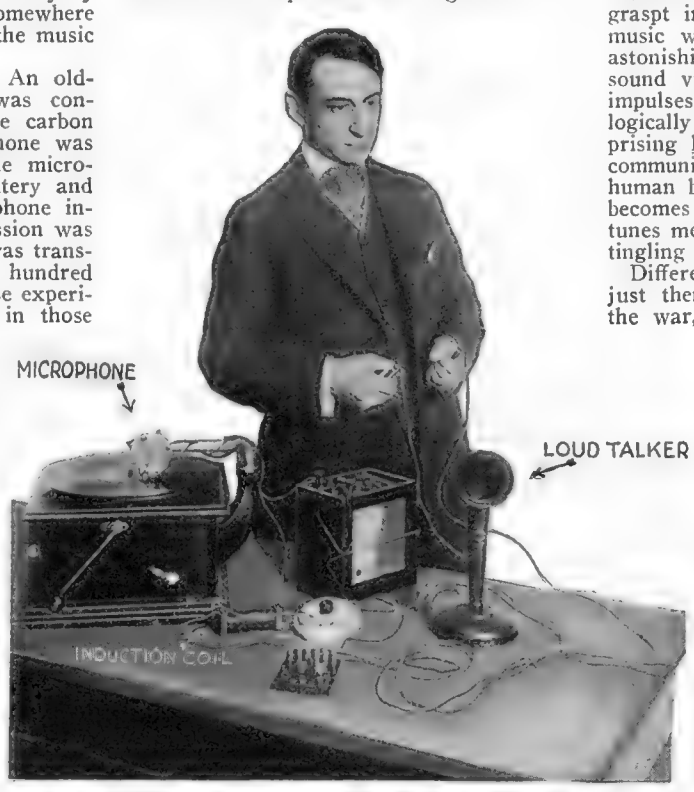
By H. GERNSBACK

WHEN I was sixteen I secured an old-fashioned Pathé phonograph of the cylindrical record type. You know the kind that was in vogue years ago. Being much interested in electricity in those days, the thought occurred to me, the same as it occurred to thousands of others, namely, why not transmit the music electrically by putting a sensitive microphone somewhere on the phonograph and thus get the music at a distance.

No sooner said than done. An old-fashioned Hughes microphone was constructed by means of three little carbon rods, and this miniature microphone was attached to the sound box. The microphone was in series with a battery and the primary of an ordinary telephone induction coil. The music transmission was excellent and phonograph music was transmitted over a distance of three hundred yards on my father's estate. These experiments created quite a sensation in those days, and my friends, all electrical "bugs," were much elated and pleased with the stunt.

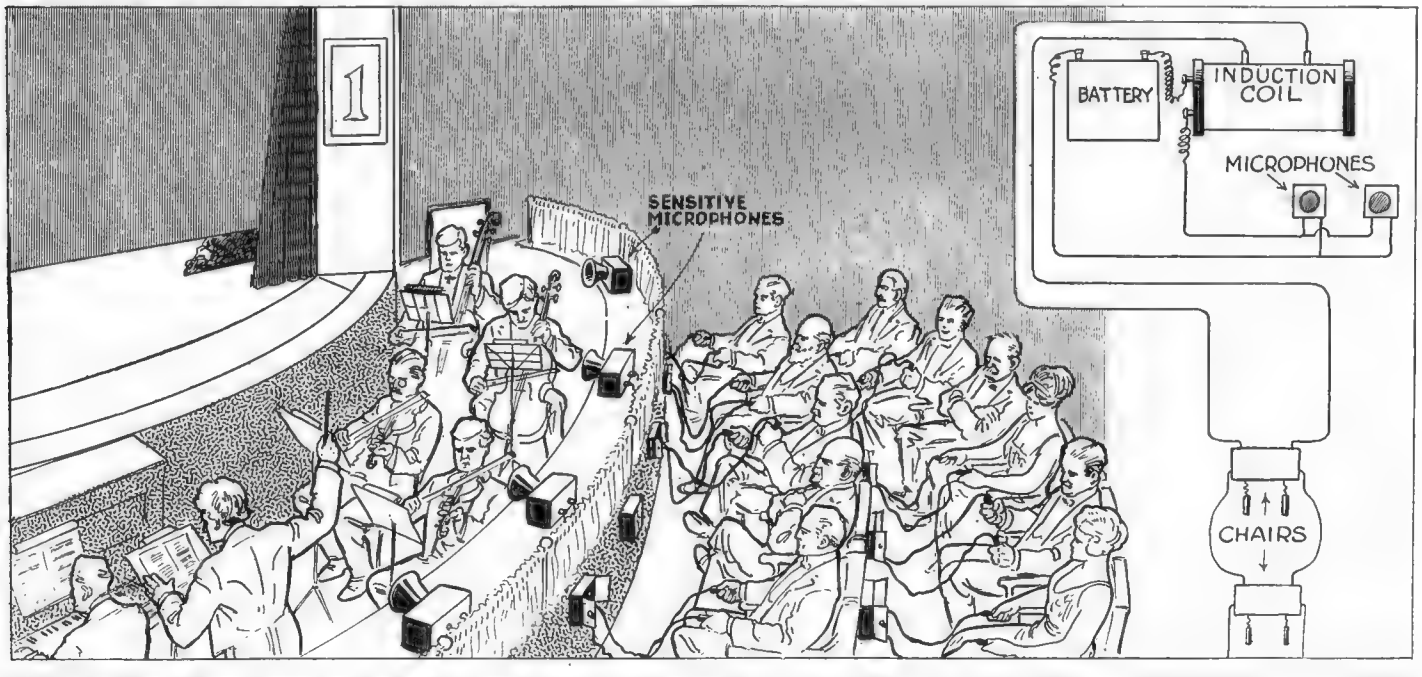
One evening I accidentally touched the two wires of the secondary terminals of the telephone coil and was quite surprised to get a smart and disagreeable shock. That was in 1900. The early experiments were soon forgotten, but in 1917, while editing an article in this magazine, where a young man had re-discovered the ancient experiment, I thought of that shock, and I understood immediately what that shock really was. I accordingly set to work and immediately built a new transmitter which was attached to a Victor phonograph sound box, and which is shown in Fig. 4. The connections are shown from which it will be seen that the microphone is in series with the 6-volt storage battery and the primary of an induction coil such as is used in telephone work.

The writer used a regulation sound box merely by making a microphone out of it and substituting a carbon diafram for the mica diafram. The space between the back carbon and the carbon diafram is filled out with polisht carbon grains. The mechanical suspension of the carbon diafram must be the same as the one for the mica-diafram. In other words, the vibrations of the phonograph needle must be faithfully past onto the carbon diafram, the same as is the case with the mica type. When the connections are correctly made and two handles are now attached to the secondary of the induction coil, and these grasped in your hands, the rhythm of the music will be felt faithfully and with astonishing fidelity. What we do feel is sound vibration translated into electrical impulses which in turn are felt physiologically by the human nerves. It is surprising how well this translated music is communicated to the nervous system of the human being, and with a little practise it becomes possible to recognize the different tunes merely by the variations of the little tingling shocks.



Mr. Gernsback Demonstrating the Physiophone. The Photograph Shows How the Instruments Are Connected. By Means of the Double Pole Switch, the Music Is Reproduced by a Loud Talker, Then the Switch Is Thrown, and Physiological Music Is Had.

Different records were tried in 1917, but just then the United States entered into the war, and the experiments came to a sudden end. Recently, however, they were taken up again with the following results. Improvements were made on the microphone and a great many new types were tried out, because the original type was not entirely satisfactory. Later experiments, however, proved to me that the 1917 type in principle was probably the best that could be produced. From some ten or twelve types which were evolved by me then, a few are shown here. Many different records were tried, and it seemed to be readily establisht that the different tunes, the different musical instruments, as well as voices, could be readily differentiated physiologically *without listening at all to the music*, or without hearing any sound whatsoever. Of course, it goes without saying that such experiments must



Double Barreled Music. Showing How an Audience Can Enjoy the Music Orally As Well As Physiologically. In Other Words You Hear the Music and You Feel It As Well. A Brand New Source of Enjoyment.

During Tests With Totally Deaf People, They All Expressed a Great Desire to Dance by Means of Physiological Music. Due to the Rhythm a Deaf Person Can Now Dance Without Any Trouble by Means of Physiological Music.

be made with the phonograph in a different part of the building with the handles so far away that the music from the phonograph cannot be heard at all. When using the microphone type as shown in Fig. 4, the sound near the phonograph is still audible, altho not anywhere near as loud as if the original mica-diafram were used.

For this reason the handles must be located in another room so that whatever music leaves the phonograph cannot be heard. I used a double-throw switch and a loud talker of the type commercially sold, and invited visitors to first listen to the phonograph record by means of the loud talker. Then the switch was thrown, and of course no sound was heard at all. By grasping the handles, the visitors could readily follow the rhythm of the record, and right here a curious thing happens.

Some people, altho musically inclined, have trouble in following the music, while others immediately recognize the different strains and have no trouble to sing or whistle with this physiological music. There seems to be a difference in the nervous system of individuals, and some people can more readily translate the rhythm than others, altho not necessarily more musically inclined. Other tests were made paralleling the idea *by using no phonograph at all,* but simply a microphone into which a person spoke. By having the experimenter count from one to a hundred, the other party at the far end could feel the voice impulses and after a while managed to "understand" the voice by physiological impulses.

In Fig. 1 is shown another type of transmitter attacht in front of the sound box in the phonograph. It consists simply of three transmitters connected in parallel, the connections being the same as usual. This, however, did not work as well, and very little could be felt at the secondary end.

In Fig. 2 is shown two transmitters, because the writer at one time when working with a single transmitter on a disc type phonograph did not receive all the impulses, that is to say, only one side of the lateral cut vibrated the diafram.

The same idea is shown in Fig. 3 where two transmitters were simply attached to the needle holder, the rubber band serving simply to feather the action, but the results in neither case were good, and the original 1917 type transmitter with certain refinements has been found to work best in all respects.

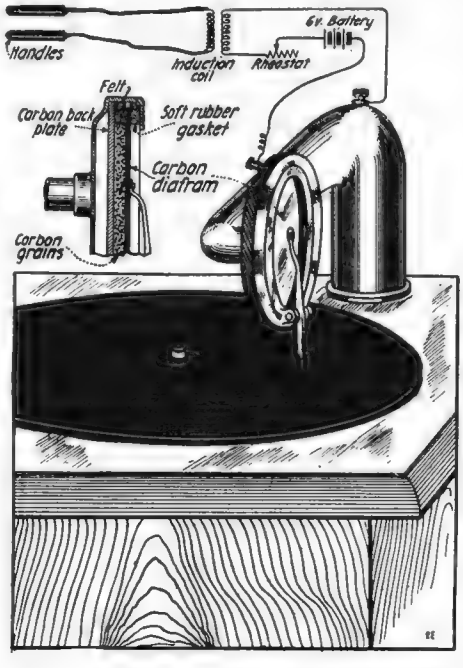


Fig. 4. Schematic Illustration of the Components of the Physiophone.

What purpose is accomplisht by these experiments? Ordinary human beings certainly do not require the translation of musical impulses into their nervous system, *but for the deaf a vast and important field has been opened.* Here we have a means of translating music into the nervous system of a deaf person who has not the slightest conception of music. Of course, it should be understood right here that I do not mean to convey the idea that a deaf person will actually "hear" the music. What he does get, however, is the rhythm, and he certainly gets this very definitely as has been actually demonstrated by tests with deaf persons upon which the writer experimented. It has been found that a deaf person can readily understand the different musical pieces, and can even recognize different musical instruments with very little practise.

Of course, the deaf person must learn the same as any other human being, for it is a well-known fact that if a person totally deaf were restored his hearing, he would not be able to understand what you said to him for some time to come. He would have to learn and judge the sound just the same as a child. The same is the case with a totally blind person who has never seen daylight. Experiments made with such people invariably prove that as soon as the eyesight is restored, they do not see in the sense that the normal person

(*Continued on page* 1320)

Electro-Medical Frauds

By JOSEPH H. KRAUS

FROM time immemorial, people of this and foreign countries have allowed a class of humbugs and fakers to foist upon them innumerable cure-all devices and medicines. Not alone have these quack doctors been charging exorbitant prices for worthless trash, but they have also caused various injuries and hardships to those attempting to manipulate or apply these worthless humbugs "as per directions."

In medicines, even today, the market is full of glaring advertisements of remedies which formerly were claimed to cure anything from a corn to a malignant tumor.

Some of these fakers and quack doctors have been enjoined from ever again manufacturing or offering for sale, *any* medicines of *any* kind and the harvests of five hundred thousand to several million dollars annually, is lost forever to them. Like all schemes of this nature, these individuals produce testimonial upon testimonial to *prove* (?) that their goods are as wonderful as they claim them to be and with the boldest effrontery, produce advertisements such as "Five Hundred Dollars will be paid to any one who can prove that these letters are not genuine, or have been solicited." This seems to pave the way to the enormous financial profits recorded by them in income tax reports and demonstrates to what an extent they have hoodwinked the Public.

It is only necessary for us to watch the continuous panorama of advertisements which bunko medicine houses use and view the daily death column in the paper to note the marked similarity of names of persons who have died of the same disease, which, two days later, the cure-all concern announces it had cured. "Dead men tell no tales" as the old adage goes, and hence, we will not stop to even question whether or not the individuals concerned in the treatment, ever had used it, but if so, the remarkable results are clearly indicated by the "slow procession."

One of the greatest frauds of all time and finally declared by the Government to be simply a scheme for obtaining money thru the mails by means of pretexts and fraudulent promises, and to which further use of the mails was denied, was the "great" and "wonderful" ACTINA humbug. Perhaps many of our readers remember this *Actina inhaler*, having probably seen advertisements of it thruout the country. This device sold at about ten dollars and later on, if the correspondents did not answer, a 50 per cent discount on any goods was offered.

Essentially, it consists of an outer casing about three inches long with a wide opening at one end, and a narrow opening at the other. An inner tube of perforated zinc about ¼ inch wide and fitting inside the first tube or casing (this made of copper). The American product, however, was entirely of steel. The space between the two walls shown in illustration (1) was filled with oil of mustard and oil of sassafras. The former smells like a decayed onion and great caution must be exercised when smelling this oil, hence the *Actina* advertisements stating that it was perfectly harmless were not only fraudulent, but also of great injurious content. This swindle "cured" *deafness, blindness, catarrh, and nervousness and a couple of other odds and ends thrown in.*

The American Medical Association, in their exposé propaganda, speaking of its effect in curing any eye or ear disease, state that the sufferer might just as well and with more safety, blow red pepper up his nose, and get his sneeze cheaper than by sniffing at a $10.00 evil smell.

This fraud claimed, in addition, to be an ozone battery, the electric action of which was due to the copper and zinc involved in its construction. We would refer the reader to several past descriptions of *real* ozone generators and recall to his mind that even the smallest of these generators was comparatively bulky and yet we find here, a company deciding that ozone can be generated by electric action (?) between the zinc and the copper, while held in the hand. Additional fakes made by the same concern were the Magneto Conservative Garment shown in Fig. 3. This garment, which was claimed to cure anything from indigestion to *locomotor ataxia,* looked like a suit of underwear with a large number of bar magnets, oodles and oodles of them, scattered thruout its interior.

Such magnetic devices never cured nor did they ever have even the slightest effect upon the individual. Such bunko devices as the magnetic hair brushes and combs, "cold feet" pads generating electricity due to the action between the copper and zinc plates, and electric belts, not only never cured, but also made themselves uncomfortable to the wearer.

Out of hundreds of claims for testimonials, not one cure could be authenticated by the use of the various devices here referred to.

In order to note the effect of magnetism on the human body, tests were made in France (see Fig. 2), which involved the use of gigantic electro-magnets capable of forming the most intense magnetic fields.

Persons placed under the effect of this ultra-powerful magnetic flux were carefully watched and every movement recorded with remarkable accuracy and precision. The pulse rate, heart beat, breathing, and reflex responses from the various nerve centers were noted and in no case was even the slightest change effected when the person was first under magnetic influence and again when the current was turned off.

This fact is well worth remembering. When once thoroly learned, people will not be bamboozled by *any* device which claims as its healing power, magnetism of any sort. Under this category, come also such ridiculous schemes and such flagrant misrepresentations as *Electro-magnetic Rings* which cure everything from nose bleed down to appendicitis, and varicose veins.

Another of the wonderful deafness cures which was perhaps more magical and mystical than the former was that of (Dr.) Branaman. This device would cure deafness or catarrh, head noises or asthma, so quickly that you would not even know it, regardless of what the deafness was due to. The poor afflicted victim was given a symptom blank which he filled out and whether he could add *yes* to every question or *no* to every question asked thereon, he was either pronounced deaf or suffering from catarrh.

The contrivance altho selling for $8.00, cost about $1.50 to make. Essentially, it is a leather belt strapt securely around the head, made in the form of a pocket. This houses the "battery." The battery is the same as employed in the audacious commercial frauds even now being advertised and manufactured in the form of belts.

These consist of a number of copper and zinc elements, the zinc being placed inside the copper. Around the zinc element is a tiny bit of felt so that when the battery is immersed in a vinegar solution an electric current is set up! These electric currents buzz thru the ears and stimulate in that way, the nerves of hearing, according to Dr. Branaman, America's *leading ear specialist* (at least he calls himself that); he even went so far as to publish advertisements in the newspapers showing the photograph of a man as being cured of deafness and blindness. This man had been deaf for years and was still deaf; and this Dr. Branaman knew. Still he persisted and continued to use the victim's name in his advertising slogans. Strange to say, a testimonial purported to have been written by the man, was printed altho the victim was so unfortunate as to be unable to write.

Even today, in some of our newspapers and magazines perhaps we find advertisements that start off with a big flare "Don't shout, use the *Morley* ear phone." This

(*Continued on page* 1312)

For "May" E. E.

Peace Time Uses for the Searchlight—A new scheme for outlining airplane field with one searchlight, by Edwin F. Linder, M. E., Specialist in Searchlight Design and Inventor of Bullet-proof Mirror.

The Automatic Telephone—Simple explanation in picture and in diagram by an expert in Automatic Telephony.

Flashlighting Birds and Animals, by Howard Taylor Middleton.

The "Loadstone" or Natural Magnet—Specially written by an expert on loadstones, with special illustrations.

A Day With the Weatherman—The rôle of electro-mechanics in foretelling your daily weather report, by H. Winfield Secor.

"Odd Photo" Prize Contest.

"House-hold Electrics" page, by Edna Purdy.

The Why and Wherefore of Magnetism, by Edward A. Keever.

How Glass Is Made—All about glass, the everyday substance about which we know so little, by Prof. Floyd L. Darrow.

Popular Astronomy, by Isabel M. Lewis, M.A.

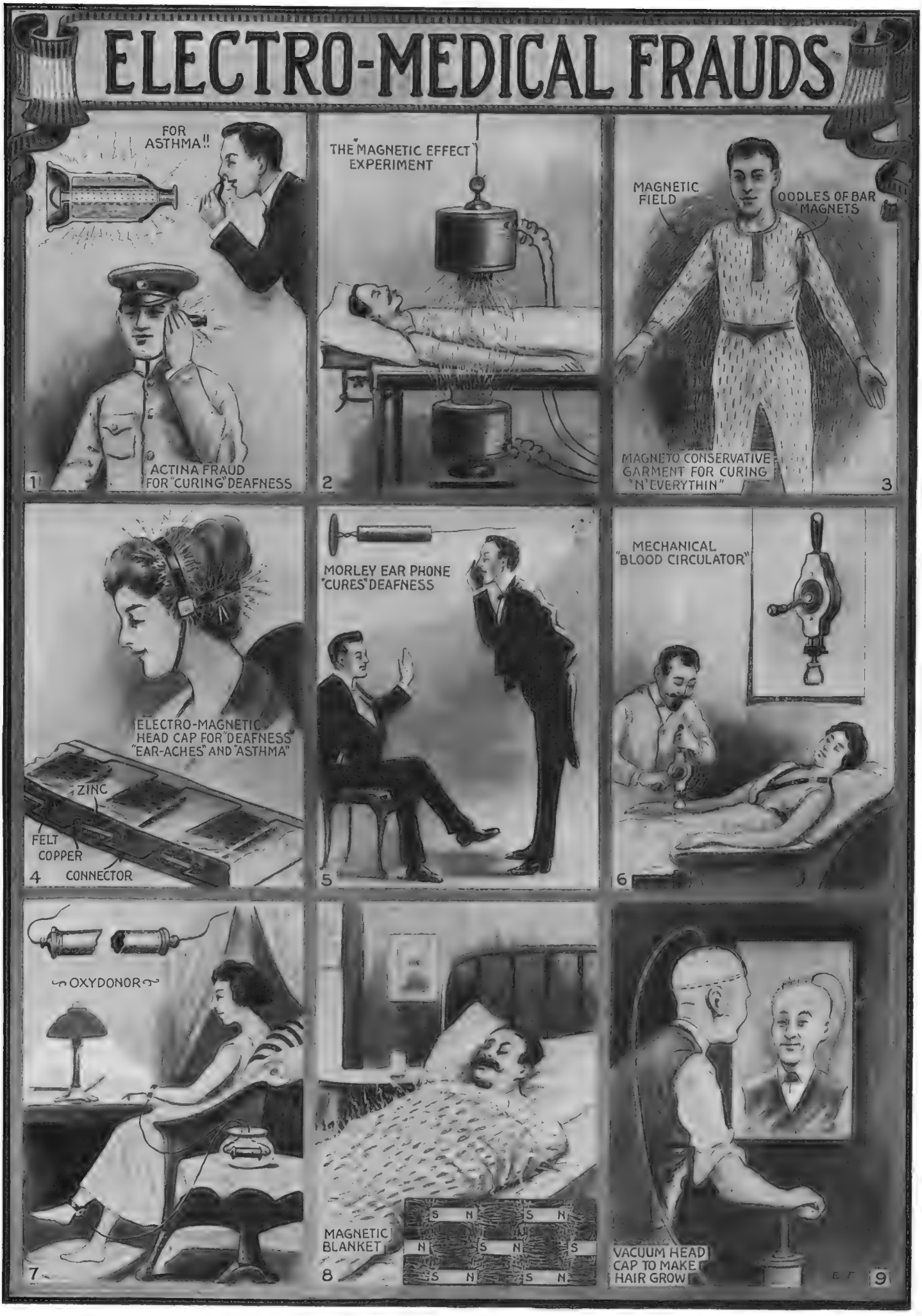
The Amateur Magician—The Mysterious "Rapping Hand" which foretells your fortune, by Joseph H. Kraus.

Long Waves and "Strays" on Rogers' Antennae, by Lieut.-Com. A. Hoyt Taylor, U.S.N.R.F.

Some Laboratory!!—An interesting story with excellent photographs of an American model worker's shop de luxe—Written as only he can write it, by Thomas Reed.

More Light for Microscopes, by Merrill M. Hunting.

ELECTRO-MEDICAL FRAUDS



FULL DESCRIPTION ON OPPOSITE PAGE.

"The Educated Harpoon"

By CHARLES S. WOLFE

THE Chief of Police gave me a hostile questioning stare. I'm not exceptionally quick witted, but I don't have to be hit with a club in order to grasp an idea. I rose instantly. "Something tells me I am *de trop*," I murmured.

My friend put out a protesting hand. "Sit down, you touchy ass," he said. "Chief, this man is a particular friend of mine. You can safely say anything in his presence. It will go no farther."

Undecided whether to go or stay, I hesitated. The Chief smiled sourly. "Oh, it's all right, Mister, if Joe here says so. But forget anything you hear, get me? We can't afford leaks."

Joe saw that I intended to go, and he crost and forced me back into my chair. "Don't mind the Chief, Bill," he said, laughingly. "He has an inherently suspicious disposition. Now then, Chief, what is troubling you?"

I gasped. I knew Joe Fenner as a fellow student, wireless telegraph enthusiast and scientific dabbler. A mighty likable, but not extraordinary, sort of a fellow. To find him on terms of intimacy—to say nothing of equality—with the Chief of our city's police force was astounding. Personally, I've always had a little fear of policemen, a relic of boyhood days and pranks. Apparently the king-bee of the whole clan had no terrorizing influence on Joe.

The Chief dropt wearily into the nearest chair. "You'll have to pardon me, friend," he growled at me, "I'm a little short on manners at the best of times, and this thing is getting on my nerves. Joe," turning to Fenner, "I want you to help us again."

I turned a mental summersault. The Chief of Police addressing my chum as Joe. Asking him to help them—again. Ye Gods! Was my seemingly commonplace chum a detective?

The Chief was speaking. "There was a man killed in the Atwood building an hour ago. I've just come from there."

My face must have reflected the varying emotions that this statement produced within me, but Joe's countenance remained passive. "Murdered," he asked, quietly. "How?"

"Stabbed in the back." The Chief might have been saying "Please pass the potatoes," for all the feeling exprest in his tones.

Joe shrugged his shoulders. "I don't think you want me, then," he said. "It's out of my line."

"Yes, you'd think so," agreed the Chief, "if it wasn't for the peculiar circumstances surrounding the crime."

"Peculiar circumstances? What's peculiar about them, anyway, Chief?" queried Joe.

"Well, for one thing, we can't find the knife, or whatever it was that he was stabbed with."

"Murderer took it away with him," suggested Fenner.

The Chief's face took on a pained look. "Maybe he did," he said, wearily, "only—there's no possible way he could get in to stab the man in the first place, and no way that he could get out after he had stabbed him in the second place. And in the third place the crime simply couldn't have been committed at all, but it was. And there you are."

"Chief, you're talking thru your hat," reproved the amazing Fenner with astounding disregard of the deference due one in the Chief's position. "There must be a perfectly simple way in which some one got into the place and away again."

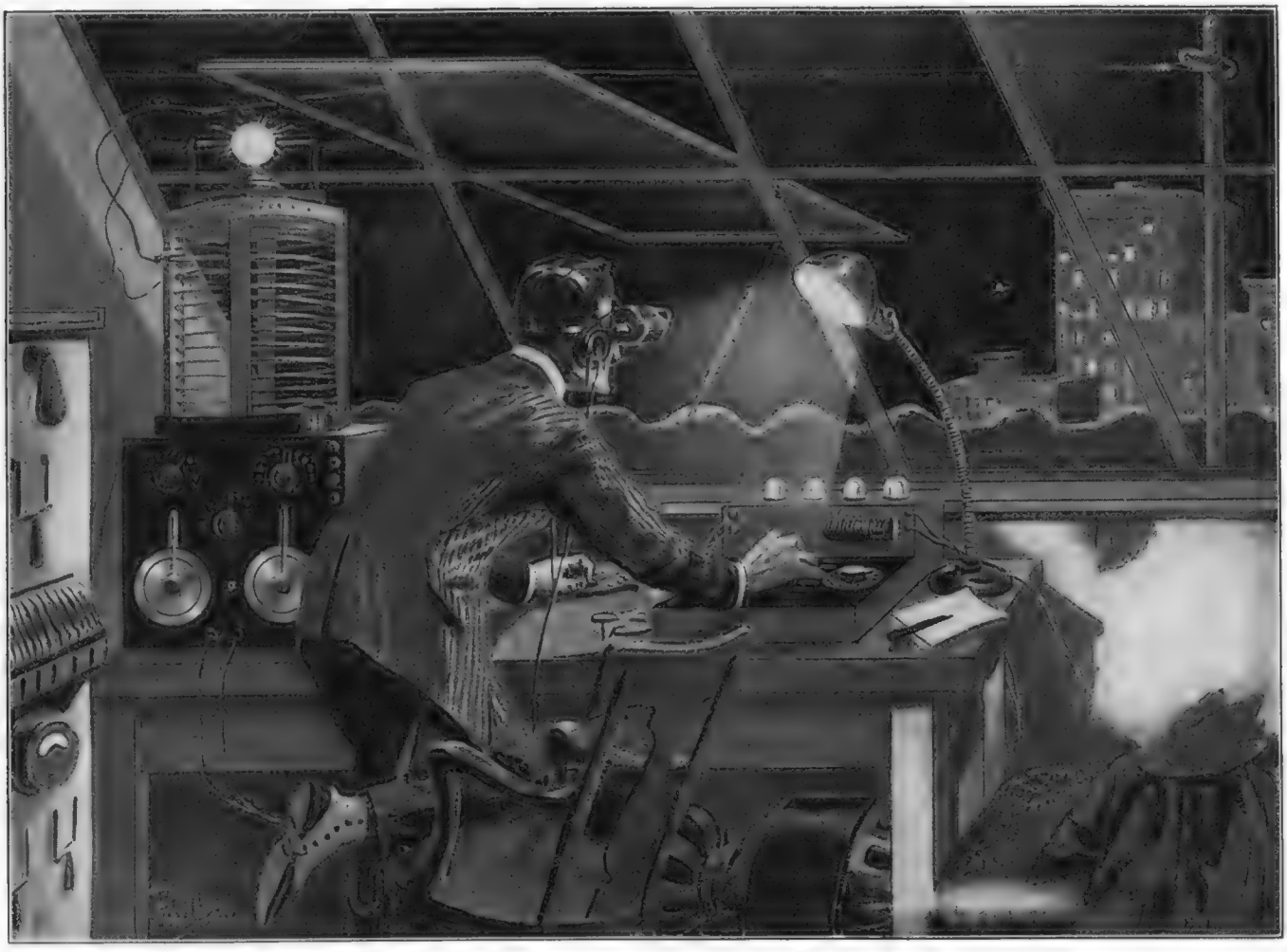
The Chief arose. "My car's outside," he said. "Come along down and have a look."

As Fenner hesitated I took my cue. "I'll ride along as far as my house if you don't mind," I said.

"You'll ride along and have a look with me," said Fenner, warmly. "I know you're just as curious as I am to get a look at the scene of this remarkable crime."

The Chief was almost friendly. "Yes,"

(*Continued on page* 1335)



This Is a Story of An "Educated Harpoon," and We Are Not Going to Tell You In a Few Words, Just What It Is or How It came About That a Great Business Man Was Murdered In His Private Office, Without Anyone Having Entered the Office, As the Facts of the Case Have Clearly Proven. However, If You Have a Fair Education In Electrical and Radio Matters, You May Be Able to Guess How the Man Was Killed. If Not, You Will Find This One of the Most Interesting Scientific Narrations Ever Written.

ELECTRIC BACHELOR MAID

The Electric Bachelor Maid Surprised Her Friends One Evening by Giving an "Electric Corn Popping" Party. A Stick to Which the Corn Popper Was Attached Waved Regularly Back and Forth When the Sewing Machine Motor Was Running.

Every Young Woman Likes Those Beautiful Blouses with Crimped Ruffles, but She Often Foregoes Buying Them Because She Has No Crimper. An Electric Curling Iron Is Not to Be Despised As a Crimper of Ruffles When One Has No Crimper.

The Electric Batchelor Maid Does Not Confine the Motor to the Sewing Machine. She Cuts a Circular Felt Buffer and Fits It Onto the Shaft of the Motor for an Electric Manicure.

Making an Electric Cracker Jar. A Hy-Lo Red Bulb Is Inserted Thru the Top of the Cracker Tin, and the Heat Is Just Right When the Light Is On 1 Day a Week.

One of the Annoying Things About "Vacuuming" Is a Tangled Cord. A Coiled Spring May Now Be Purchased, or Made by the Handy Mechanic.

Efficient Brushing by Motor. The Brush Connected to the Shaft of the Motor Revolves, and Its Speed Is Regulated by the Foot Pedal of the Motor.

Here Is a New Combination in Electrical Devices. It Is a Curling Iron, the Center Rod of Which May Be Pulled Out from the Handle, and Screwed Into a Hot Water Bag to Keep the Water Hot as Long as Needed.

A Nitrogen Lamp Held or Clamped to a Tin Dipper for a Reflector, Gives a Surprising Amount of Heat, Which May Be Directed Over the Entire Head or Used to Dry a Section.

Telegraph, Cable and Radio Dispatches

By PIERRE H. BOUCHERON, Ensign U.S.N.R.F.

POSTAL TELEGRAPH — COMMERCIAL
TELEGRAM
JAMES BROWN AND CO
7980 North Chestnut Street,
Chicago, Illinois.
WIRE PRICES ON STOCK A AND B IMMEDIATE DELIVERY FOB.
LAWSON & SONS
(Check 10 words)
Note: Only words in text are counted
CABLEGRAM
PACIFIC
ATLANTIC
"VIA COMMERCIAL"
NEWTONCO PARIS (FRANCE)
CAMPOSTONE NOMADIZOLOR
SOMBROASTE ZEENUSTONG
(Check 7 words)
Note: All words counted except country of destination.
MARCONIGRAM
MARCONI WIRELESS TELEGRAPH COMPANY OF AMERICA
Send the following message "VIA MARCONI", subject to the terms on back hereof, which are hereby agreed to.
JAMESON, STEAMER CARACAS (via) CAPEHAY
WHEN DOES SHIP ARRIVE NEWYORK.
THOMPSON
(Check 10 words)

The Accompanying Illustration Shows the Three Principal Forms of Business Messages as Commonly Transmitted by TELEGRAM, CABLEGRAM and WIRELESS or MARCONIGRAM. The Underlying Key-Note, in Writing Out These Messages for Transmission, Is of Course Brevity, with a Capital "B." Many Useful and Practical Hints for the Correct Preparation of Such Messages Are Given by the Author in the Accompanying Text. Altho the Preferred Forms of These Messages Are Known Fairly Well to Everyone, Yet It Is a Fact That a Brief and Fully Complete Message Which Shall Not Be Misunderstood by the Recipient, Rarity

LARGE corporations of today do not waste and take up the valuable time of high-salaried executives by leaving it to them to prepare and properly route the dispatches of the firm in the most economical way. Instead a specially trained clerk, preferably one who has had experience in a telegraph or cable office, is assigned to this work, and all telegrams, cablegrams and radiograms must be routed thru him before forwarding. However, since it is not every organization whose business warrants the employment of such a clerk, nevertheless the smaller concerns may profit by some timely information on this subject. Particularly is this needed today, for in the mad scramble to "get the business" little details like economy in the use of words in telegrams and cablegrams are seldom taken seriously.

The writer, who during the war had an opportunity to study various systems of communications, both government and commercial, was surprised at the lack of common sense and knowledge displayed by some firms and individuals when sending dispatches. In some instances no efforts were made to economize in the use of words, and in a fifteen-word cablegram as many as five unnecessary words would be used, which in the case of messages destined to remote points, costing 42 cents per word, meant a loss of $2.10. On the other hand, there were those who were seeking economy by the wrong methods, and thru lack of proper knowledge of rules would attempt to combine words in an illegitimate manner in order to lower the cost of the message. In either case much money and time was lost in harangues and disputes between themselves and the cable clerks, which could have been avoided by securing the necessary information in very short order from competent telegraph clerks or from other experienced persons.

Besides the telephone there are three general means of rapid verbal communication with distant points as follows and in the order of their importance:

1. The telegraph.
2. The cables.
3. The wireless.

THE TELEGRAM.

The telegraph as a means of communication is usually resorted to in this country where the telephone is too expensive, or where the special delivery mail is too slow, and of the three mentioned above is the most commonly known and used.

CLASSES OF SERVICE.

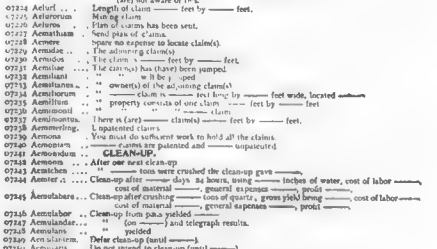
There are four classes of messages which may be sent by telegraph:

(1) The telegram, for which full rate is charged and which is given expedited transmission. It may contain ten or less words for the same charge, additional words being charged for according to rate per word.

(2) The night message, which is handled during the night only when traffic is small and for which reduced rates are charged. This message is usually delivered in the morning of the following business day.

(3) The day letter is transmitted during slack periods of the day and may contain fifty words or less. This form of message is charged for at one and one-half the charge of a regular ten-word day telegram, additional words being charged for at the rate of one-fifth of initial rates for each additional ten words or less.

(4) The night letter is handled in practi-


CLAIMS.

07811 Aelfgive ..... Claim has been surveyed
07812 Aelfade ..... Claim has been surveyed
07813 Aelfane .. Claim is one of the best prospects in the district.
07814 Aelfanes .... Claim(s) must be patented
07815 Aelin .. Deep level claim(s).
07816 Aelipe..... Diminishment of the claim(s)
07817 Aelipos .. Your claim(s) will be jumped
07818 Aelius .. Have claim surveyed
07819 Aelpier .. " done sufficient work to hold (all) the claim(s).
07820 Aelperm .. " claim(s) been patented?
07821 Aeliant .. How many claims are patented and how many unpatented?
07822 Aeltester .. It is very important to buy the adjoining claim(s).
07823 Aeltalk..... " " " " claim, as the vein runs into it, the owner(s) is
(are) not aware of this.
07824 Aelurl .. Length of claim —— feet by —— feet.
07825 Aelurorium .. Main ore claim
07826 Aeluros .. Plan of claims has been sent.
07827 Aematham .. Send plan of claims.
07828 Aemere .. Spare no expense to locate claim(s).
07829 Aemidae .. The adjoining claim(s)
07830 Aemidos .. The claim is —— feet by —— feet.
07831 Aemilae .. The claim(s) has (have) been jumped.
07832 Aemiliani .. " " will be jumped
07833 Aemilianus .. " owner(s) of the adjoining claim(s)
07834 Aemilorum .. " —— claim is —— feet long by —— feet wide, located
07835 Aemilium .. " property consists of one claim —— feet by —— feet
07836 Aemimond .. " " " —— claim
07837 Aeminentus. There is (are) —— claim(s) —— feet by —— feet.
07838 Aemmerling. Unpatented claims
07839 Aemona .. You must do sufficient work to hold all the claims.
07840 Aemonium .. —— claims are patented and —— unpatented
07841 Aemondeus .. CLEAN-UP.
07842 Aemoon .. After our next clean-up
07843 Aemthen .... " —— tons were crushed the clean-up gave ——.
07844 Aemter .. Clean-up after —— days 8 hours, using —— inches of water, cost of labor ——,
cost of material ——, general expenses ——, profit ——.
07845 Aemulabare... Clean-up after crushing —— tons of quartz, gross yield being ——, cost of labor ——,
cost of material ——, general expenses ——, profit ——.
07846 Aemulabor .. Clean-up from pans yielded ——
07847 Aemulandae... " (on ——) and telegraph results.
07848 Aemulans .. " yecided
07849 Aemulatrum. Defer clean-up (until ——).
07850 Aemulatus .. Do not intend to clean-up (until ——).
07851 Aemulous .. Found on cleaning-up (that ——)
07852 [illegible] Have cleaned-up after crushing —— tons of quartz gross yield ——
07853 [illegible] Partial clean-up.
07854 [illegible] Result of last clean-up was ——.
07855 [illegible] Shall arrange to clean-up.
07856 [illegible] clean-up.
07857 [illegible] " not clean-up that month (on account of ——).
07858 [illegible] Suggest clean-up.up
07859 Aemulous .. The clean-up fairly indicated the value of the ore.
07860 Aemulum .. Unable clean-up cannot give actual results of ——
07861 Aemulus .. What do you intend to clean-up?
07862 Aemulusli .. CLIENTS.
07863 Aemulus .... Advise clients ——
07864 Aemulying ... Ask the client to telegraph us, or to authorize you to do so
07865 Aemulus .... Can one of client's firm come immediately, no one but principal may sign necessary papers
07866 Aenean .... Cannot advise, clients must judge for themselves
07867 Aenaeidae ... Client(s) advise ——
07868 Aenaetiones ... " left today (for ——).
07869 Aenaetium ... " instruct ——.
07870 Aenaetum .. " on his way (to ——).
07871 Aenaetur .... " out of town, impossible to state to-day.
07872 Aenaetuves .... " must be prepared for a hard fight
07873 Aenatoris .... " will buy if funds can be secured for the purpose.
07874 Aenatum.... " " entertain proposition.
07875 Aenealae .... " " investigate
07876 Aeneide..... " " not entertain proposition
07877 Aenidae..... " " leave (——) (for ——).
07878 Aenolae ..... " " reply.
07879 Aenolarum .. Have advised all clients.
07880 Aenolus.... " " suggested to clients as advised.
07881 Aenolum.... Not to clients.
07882 Aeqsiages.... Notify clients immediately.

A Page from One of the Famous Telegraph and Cable "Code Books" (Lieber's Code). By the Use of a Single "Code Word" You Can Transmit a Whole Sentence, Thus Reducing the Cost Remarkably.

cally the same manner as the night message, but may contain fifty or less words, and is charged for at the same rate as a regular day telegram for fifty words. Additional words are charged for at the rate of one-fifth of the regular day message rate for every ten words or less.

Note: Day and night lettergrams must be written in plain English, foreign language, code or cipher not being accepted by telegraph companies.

The domestic telegraph message differs essentialy from the cable and wireless in that the text is the only part charged for; the address and signature being sent free of cost to the sender. Some essential and general rules regarding the transmission of telegraph messages may be briefly described as follows:

(1) The complete address as well as one signature are not counted nor charged for.

(2) Any dictionary word of a recognized language, that is, the English, German, French, Italian, Dutch, Portuguese or Latin, may be used and will be counted as one word, no matter how many letters the word contains.

(3) All numerals, decimal points, punctuation points, whether isolated or together, are counted and charged for as one word each.

(4) Names of places, states or countries, such as New York City, Havre de Grace, Camp Dix, District of Columbia, East St. Louis, South Orange, may be combined and counted as one word each, and in order to simplify counting, should be written thus: Newyorkcity, Havredegrace, etc.

(5) Mutilated dictionary words, written together contrary to accepted usage of the language, or combinations of several dictionary words will be counted and charged for according to the number of words they are composed of. For example, such words as "firstclass," "allright," "postoffice," etc., are counted as two words.

(6) Such words as "parcelpost," "percent," "carload," "O.K.," "A.M.," "P.M.," "C. O. D.," "F. O. B.," are counted and charged for as one word each, because these are recognized by custom to be single words.

(7) Code words and cipher words may be used. Code words not exceeding ten letters, and cipher words not exceeding five letters are counted and charged for as one word each.

(8) Only one address and one signature are allowed in one message, two or more signatures being charged for as so many extra words, whichever the case may be.

(9) Numerals in the body of a domestic message are counted and charged for as one word for each individual numeral.

Photo Courtesy Donald McNicol.

And Speaking of the Dispatch of Telegraph Messages—Here Is the "Distribution Board" Which Links Our Local Telegraph Office, Manned by Two or Three Operators, with the Large Staff of Telegraphers in the Main Telegraph Exchange in New York City. Each Operator's Position on the Long Dispatch Tables Is Connected with a "Tell-Tale" Signal Lamp on the Front of the Switchboard. The Operator, who Sits in Front of this Board, Can Thus See at Any Instant Just Which Operators Are Idle. A Branch Exchange, Desiring to Transmit a Message, Signals Thru a Lamp on the Table of the Board, and All the Operator Has Then to Do Is to Take One of the Plugs Beside This Lamp and Connect It with a Jack Connecting with an Idle Operator. The Battery of Relays on the Right-Hand Side of the Frame Are Connected to the Various Branch Exchange Circuits and Cause the Signal Light in Each Case to Remain Lit Until Connection Is Properly Made by the Distribution Operator.

THE CABLEGRAM.

The cablegram is a more complex and detailed subject than the domestic telegram, and in order to avoid errors requires judgment and accuracy on the part of the sender. One reason for this is that it is usually sent to foreign lands, which entails handling by many hands, and the cost is considerably greater per word than the telegram. In the case of the cablegram, every part of the message is charged for with one exception —the name of the country to which it is destined, such as France, Italy, etc. In preparing the message these names are usually bracketed to avoid counting and charging for them. The manner of counting words is known and usually referred to as the "cable count,' which same is also employed in checking wireless messages or radiograms. Owing to the fact that cablegrams are expensive, commercial houses make extensive use of code and cipher in order to lessen the number of words and therefore reduce the cost.

Several well-known codes in commercial use today are:

ABC Codes, 4th and 5th Editions.
Lieber's Improved Code.
Western Union Code.
A. I. Code.
Bentley's Code.
Century Code.
Scott's Code, 10th Edition.
Riverside Code.
Imperial Code.
Bromley's Code.
Broomhall's Code.

Typical code words: Codiac, Gopher, Staticallo, Nomadimice.

DIFFERENCE BETWEEN PLAIN LANGUAGE, CODE AND CIPHER.

Plain language, as referred to in cablegrams or radiograms, may be any language using the Latin alphabet and Arabic system of numerals. In using plain language in a cable or radiogram any legitimate word may be counted as one word up to and including fifteen letters; beyond that point and for each additional fifteen letters it is considered and charged for as two words, tho the word need not necessarily be disconnected. For instance, the word "unconstitutional," which contains sixteen letters, is *counted as two words.*

Code language consists of genuine or artificial words of a pronounceable nature, but which may have a different face meaning and are counted and charged for at the rate of ten letters to the word. When code words of an artificial nature exceed ten

(*Continued on page* 1298)

Many of Us No Doubt Entertain the Idea That There Are Two or Three Undersea Cables Spanning the Atlantic Ocean Between Europe and America, but a Glance at This Latest Cable Map of the Atlantic Ocean Tells a Different Story. There Are, in All, Seventeen Cables Linking the Old and the New Worlds.

Weighing The Earth

By LOUIS DERR

Professor of Physics, Massachusetts Institute of Technology.
Specially Written for the Electrical Experimenter

IF the earth could be weighed like a load of coal, how much would it weigh? Is it composed of light materials principally, or heavy ones? How can anything be learned about the matter? It is the purpose of this article to give a brief outline of some of the methods by which questions like these are answered.

Sir Isaac Newton's celebrated law of universal gravitation, publisht in 1687, states that every particle of matter attracts every other particle *with a force proportional to the product of their masses, and inversely proportional to the square of the distance between them.* As may readily be imagined, the law was deduced from astronomical facts, and finds its most important applications in astronomy, for by it the motions of the moon, the planets and other celestial bodies are determined.

There are, however, too many unknown factors in the formula to make it directly available for calculating the mass of the earth from astronomical data. Five quantities are involved, of which four must be known in order to calculate the fifth; the force between the two bodies, their respective masses, the distance separating them, and a numerical constant whose value depends on the units in which force, mass and distance are exprest. If we wish to know the mass of the earth in pounds or tons, *we must take some selected body on the earth's surface and compare the earth's attraction for it with the attraction of some other known body for it, at a known distance.* The working difficulty is that bodies of manageable size, separated by controllable distances, exert so feeble a gravitational pull upon each other that the measurement is a problem of considerable magnitude.

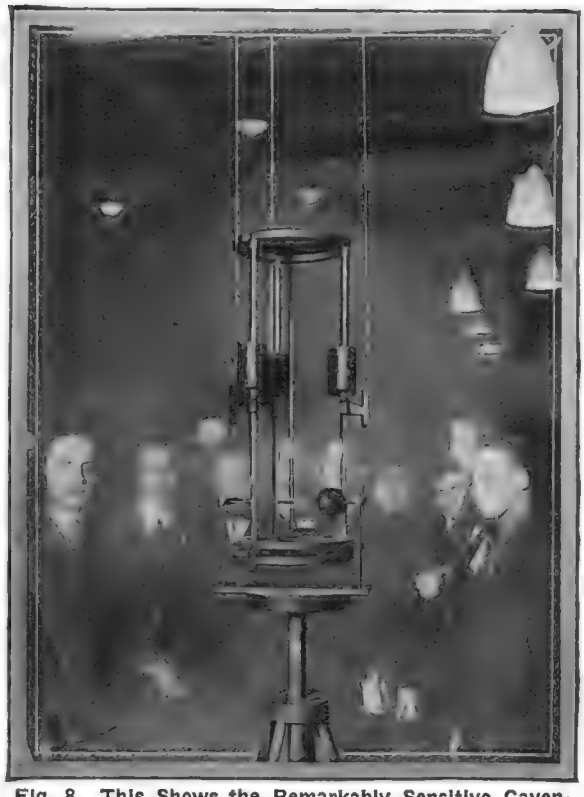


Fig. 8. This Shows the Remarkably Sensitive Cavendish Type Apparatus With the Small and Large Lead Balls, Reflecting Mirror, Etc., Actually Used in Determining the Weight and Density of the Earth, at the Present Date, by Professor Louis Derr and His Associates at the Massachusetts Institute of Technology, Cambridge, Mass.

Fig. 1. Diagram Showing How the French Physicist, Bouguer, Attempted to Weigh the Earth by Noting the Pull of a Mountain Mass on a Suspended Bob, or Weight, in 1740. A Deflection of 16 Seconds of Arc Was Actually Observed, and From This Ratio, as Compared to the Pull of the Earth Upon the Bob, It Was Possible to Compute the Average Density of the Earth.

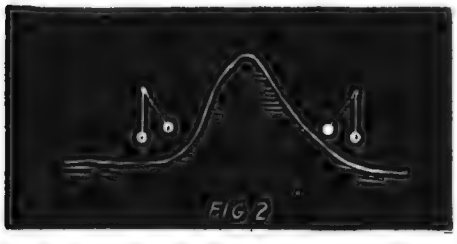


Fig. 2. This Shows the Arrangement Followed by Rev. Nevil Maskelyne in 1774, in Which Case He Chose a Mountain in Scotland for His Experiments. One Plumb Line Was Placed South of the Mountain, and Another North of It. The Ratio Between the Pull of the Earth and the Pull of the Mountain Was Readily Observed, and the Density of the Earth Then Computed.

The problem is an old one, and has been attacked many times and from many angles. The results obtained are usually given in figures representing the average density of the earth, a quantity of perhaps more scientific interest than the mere statement of its mass. Of course, if the mass and volume are known the average density is found simply by dividing one by the other.

Perhaps the earliest definite results are those obtained by the French physicist, Bouguer, about 1740. He hung up a plumb-line, ten miles east of the great mountain mass of the Cordilleras in Peru, and then moved it close to the mountain range. He reasoned that if the mountains exerted any attraction for the suspended bob, the line would no longer hang vertically, but would be tipt slightly. This is shown in Fig. 1.

The deflection was actually observed, and was found to be about sixteen seconds of arc. This gave a ratio between the *pull of the mountain on the hanging bob* and the *pull of the earth upon it* (its weight, of course) and from this ratio it was possible to compute the average density of the earth, which was figured out as about twelve times the density of water. The experiments were carried out with great difficulty, and the result is now known to be much too large, but Bouguer's work was of pioneer importance in that it showed that the earth is denser than water, that it could not be regarded as hollow, in view of the large average density, and that mountain masses do attract.

In 1774 the Rev. Nevil Maskelyne, Astronomer Royal of Great Britain, employed a somewhat different method, choosing a mountain in Scotland for his experiments. Fig. 2 shows his arrangements. One plumb-line was placed just *south* of the mountain, another just *north* of it. Now, from the known circumference of the earth and the measured distance between the plumb-lines, the difference of longitude between the two stations could easily be calculated, and the angle between the vertically hanging plumb-lines would have been 41 seconds of arc if the mountain were not there. Actually the angle was 53 seconds, *the mountain having pulled the plumb-line six seconds out of the vertical on each side.* This is indicated in the figure.

From this, as before, the relative pull of the mountain and the earth on the suspended bob could be determined, and when geologists had studied the mountain and estimated its mass the mass of the earth could be easily computed. Its average density came out 4.71 times that of water. Other trials, near Edinburgh, gave 5.32.

The weak point of the method is the difficulty of accurately estimating the mass of the attracting hill or mountain, and therefore the results obtained by methods involving the measurement of earth masses cannot be accepted as accurate. It is obviously necessary to have everything under complete control, and this has been accomplisht in several ways.

Poynting's method (1890) is as follows: Two metal balls were carefully counterpoised on a very delicate balance, and the position of the balance pointer noted by an observer looking through a telescope from another room. Then a huge ball of lead weighing 350 pounds was cautiously moved to a position just below one of the sus-

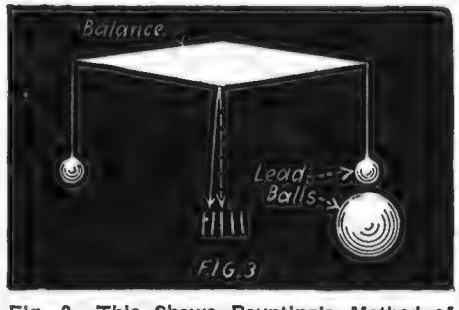


Fig. 3. This Shows Poynting's Method of Weighing the Earth. Two Metal Balls Were Carefully Counterpoised on a Delicate Balance or Scale. A Large Ball of Lead Was Then Moved to a Position Just Below One of the Suspended Balls and Its Direction Caused the Balance to Tip. The Pull of the Large Ball Could Thus Be Weighed Directly, Having Been About One Millionth of a Pound.

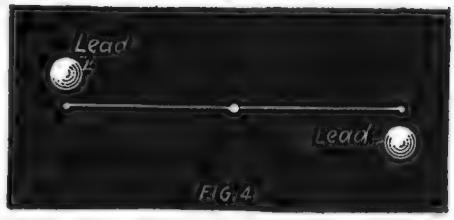


Fig. 4. This Illustrates a More Advanced Method of Weighing the Earth, Devised by Henry Cavendish, in London, in 1798. In This Case Two Small Metal Balls Are Suspended From a Fine Wire, and Two Larger Lead Balls Are Then Placed, One Behind and the Other in Front of the Suspended Balls. The Attraction of the Large Balls Thus Deflected the Rod Carrying the Small Masses, and This Deflection Could Be Recorded or Thrown on a Screen, by Means of a Mirror Mounted on the Suspension Wire and on Which a Beam of Light Was Focused.

pended balls, and its attraction caused the balance to tip slightly, as indicated in Fig. 3. The pull of the 350-pound ball was thus weighed directly; in the actual experiment it was about *one millionth of a pound.*

But the most accurate results of all have been obtained thru a method devised by Rev. John Mitchell. He did not live to carry out his project, and the experiments were first made by Henry Cavendish in London, in 1798. Cavendish took a slender rod seven feet long with a small metal ball at each end and suspended it horizontally by a very fine wire. A large ball of lead, twelve inches in diameter, was then brought up in front of one of the suspended balls, and a second lead ball of the same size placed behind the other suspended ball, as shown in plan in Fig. 4. The attraction of the large balls thus deflected the rod and the hanging balls, until the deflecting pull was just balanced by the twist in the wire. The force was then calculated from the deflection.

Within recent years the apparatus of Cavendish has been much improved and given vastly greater sensitiveness, especially by Prof. C. V. Boys, a noted British physicist. Fig. 5 shows one form of the apparatus.

The suspended balls weigh one-fortieth of an ounce each, and are about an inch and a half apart. The large attracting masses are of lead, about the size of a baseball, and weigh about six pounds each. The suspension is a fine thread of quartz, eighteen inches long and about one-twelfth the diameter of a human hair. Fig. 6 shows the quartz thread and a human hair equally magnified, and it must be admitted that the quartz thread is much the handsomer of the two. The fibers are made by melting the edges of two quartz crystals together and then quickly separating them, just as glass threads may be drawn by heating a glass rod in the middle and pulling the ends apart.

The deflection, which is very small, may be made visible to an audience in the following way. A tiny mirror is fastened to the little rod carrying the swinging balls, as shown in Fig. 7, and a narrow beam of light from an electric lamp is reflected from the mirror upon a scale on a distant wall. Any motion of the mirror is thus shown by a displacement of the spot of light on the wall, and the device practically amounts to putting a long pointer on the swinging arm, a pointer of any desired length, perfect stiffness and *no weight!*

The apparatus requires various accessories, an extremely steady support for the suspended balls being the most important. This steadiness is obtained by mounting the swinging system on a heavy iron frame or cage hung from a bracket on the wall of the room and provided with large adjustable weights at its extremities. These weights are set by trial at such points as to destroy accidental vibrations as completely as possible, and when properly adjusted they are very effective. Fig. 8 shows the arrangement worked out at the *Massachusetts Institute of Technology.*

The experiment, tho not spectacular, is nevertheless a striking one, and is occasionally shown at some of the larger colleges and technical schools. With the apparatus at rest, the spot of light on the wall is almost motionless, perhaps quivering a little when someone treads heavily on the floor above. But when the large lead balls are moved into position, altho nothing apparently happens for a minute or thereabouts, the spot of light then begins to creep slowly over the scale with a motion that very slowly but surely increases *until the displacement is a yard or more on a wall forty or fifty feet away.* No haste can be expected, for with the apparatus illustrated the force on the little balls is no greater than the weight of about one one-hundred-thousandth of an inch of human hair!

Fig. 7. This Diagram Shows How a Narrow Beam of Light Is Reflected From a Mirror on the Quartz Fiber, Suspending the Swinging Balls in the Cavendish Balance, Used in Determining the Density and Weight of the Earth.

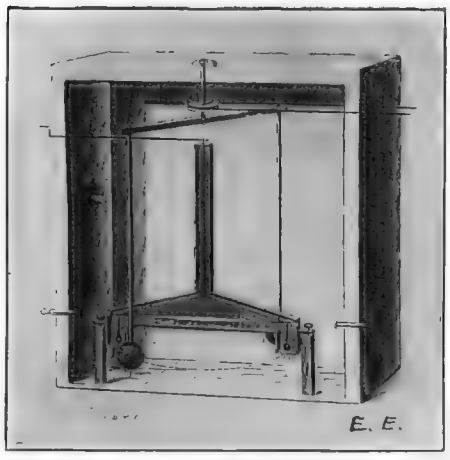


Fig. 5. The Early Cavendish Apparatus Is Shown at Left. A More Modern Type of Cavendish Balance Is Shown at the Right, and Which Was Much Improved and Gained Vastly Greater Sensitivity Under Development by Prof. C. V. Boys, a Noted British Physicist.

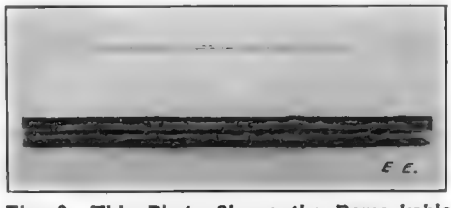
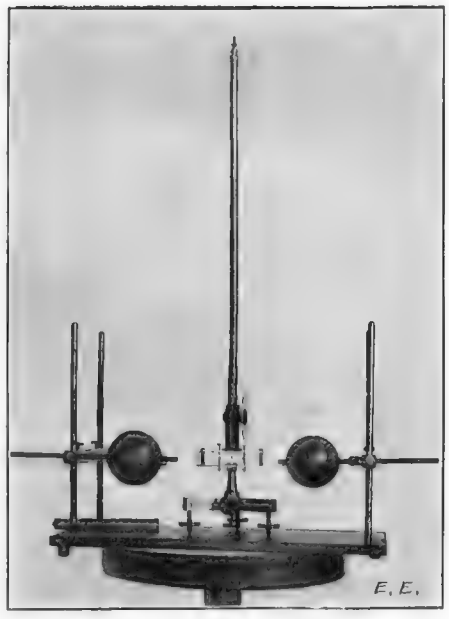


Fig. 6. This Photo Shows the Remarkable Smoothness and Even Diameter of a Quartz Thread Compared to a Human Hair, Both Equally Magnified. The Quartz Thread Is Used to Suspend the Two Small Balls in the Cavendish Balance.

The "conscientious objector" now rises to ask how it is possible to measure a force so absurdly small, and the answer is that the force is not measured directly, but obtained by calculation. By knowing the weights and the dimensions of the swinging parts of the apparatus, and the time required for a complete swing back and forth (just as the balance wheel of a watch swings), it is possible to calculate the force required to produce any given deflection, and in this way the pull of the lead balls on the suspended system may be figured. With the apparatus shown, one complete swing requires about three-quarters of an hour.

To sum up: The experiment determines the actual force between two known masses, at a known distance apart. If we consider a ten-pound ball lying on the ground we have a closely similar case. We know the pull of the earth on the ten-pound ball—obviously ten pounds' weight. We know the distance between the ball and the attracting center of the earth—four thousand miles. We know the mass of the ball—ten pounds. With the Cavendish apparatus we start by knowing the distance and both masses, and then determine the force; with the ten-pound ball on the ground we start with a knowledge of the force, the distance and one of the masses, and compute the other mass—*the mass of the earth.* A simple proportion, derived from the experiment just described, then gives the mass of the earth directly.



The resulting figure is so stupendous that it is utterly meaningless: the mass of the earth is 6,000,000,000,000,000,000,000 (six sextillon) tons. It may be added that its average density is 5.52 times that of water.

THE "UNIVERSE" ON A SMALL SCALE.

"Mars always challenges interest," says William Joseph Showalter in a recent communication to the National Geographic Society.

"It is quite generally believed that Mars has ice-capt poles. The telescope reveals white spots at the poles that have every appearance of being like our ocean Polar region. They advance toward the equator in winter and retreat in summer. In the summer of 1916, Pickering, who, with Lowell, has led the school of astronomers who believe they can see canals on Mars, said that he found the white caps stretching farther down toward the equator than he had ever seen them before.

"He said that if there was any connection between the weather of Mars and that of the earth the winter of 1916-17 would be the coldest in many years. It was true. May it yet be possible to do long-range weather forecasting on the earth by studying the waxing and waning of the ice-cap on the South Pole of Mars?

"Perhaps our most graphic picture of the solar system is given by Herschel. Imagine a circular field two and a half miles in diameter; place a library globe two feet in diameter in the very center; eighty-two feet away put a mustard seed. The globe will represent the sun and the mustard seed Mercury.

"At a distance of 142 feet place a pea, and another at 215 feet. These will represent Venus and the earth both as to size and distance. A rather large pinhead at a distance of 327 feet will speak for Mars, and a fair-sized tangerine a quarter of a mile distant will stand for Jupiter. A small lemon at two-fifths of a mile will play the rôle of Saturn, a large cherry three-fourths of a mile distant will answer for Uranus, and a fair-sized plum at the very edge of the field will proclaim Neptune.

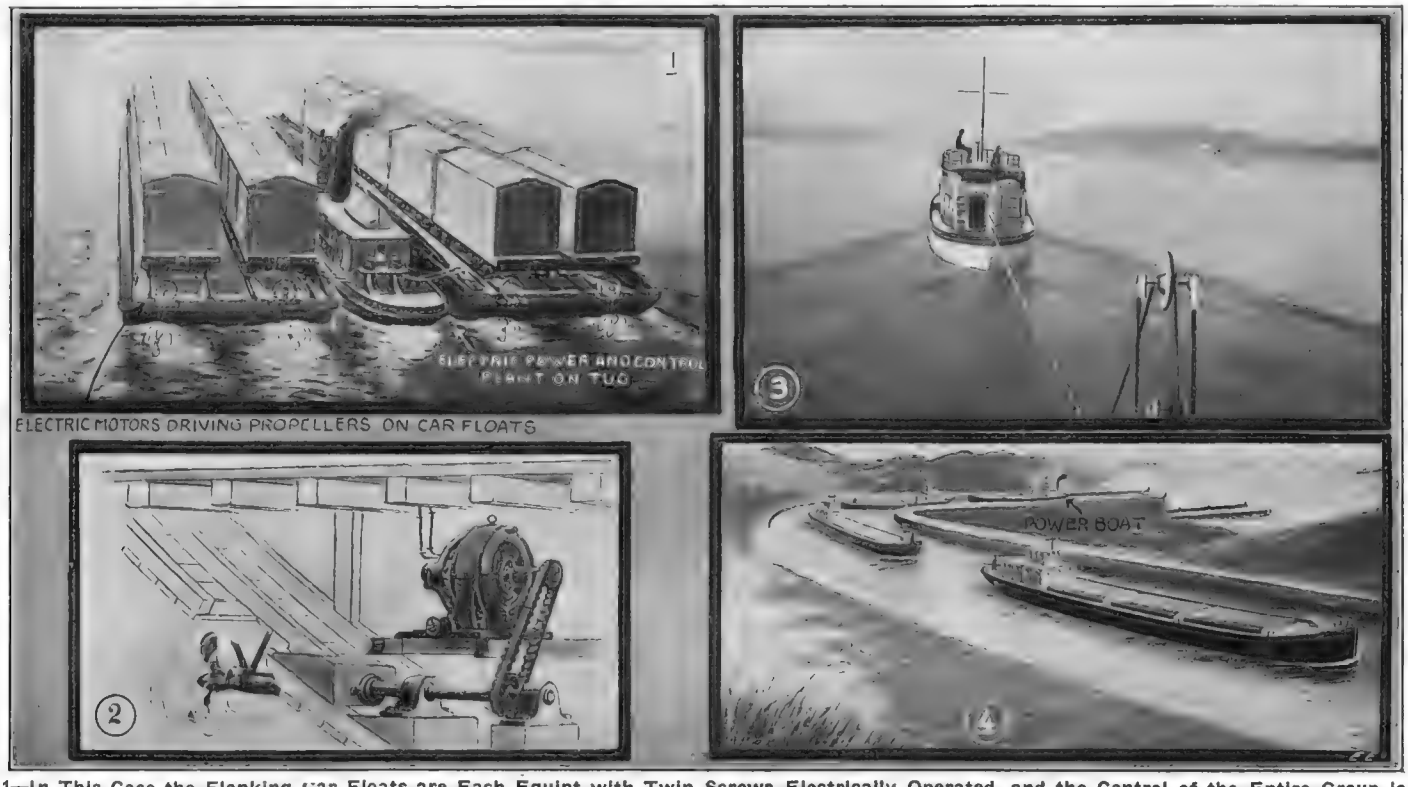
"Eighty moons would be required to make one earth. A player there could throw a ball six times as far as it can be thrown on American diamonds. A man weighing 150 pounds there would weigh 900 on the earth."

Electrifying Canal Boats and Barges

By ROBERT G. SKERRETT

Marine Transportation by Electrified Trailers

THE towboat of to-day does not make the most of its store of mechanical energy. It fails for a variety of reasons, but primarily because its screw or screws are incapable of getting a full grip upon the water when drawing one or more powerless craft. A propeller to be efficient must actually advance thru the water proportionately to its speed of revolution, and the force of its drive is dependent upon the number of times it turns in the course of a minute. If it revolves rapidly without moving on it churns up the water, pumps down air, and, to a more or less pronounced extent, whirls around in a mixed or agitated medium which is hard to get hold of effectively.



1—In This Case the Flanking Car Floats are Each Equipt with Twin Screws Electrically Operated, and the Control of the Entire Group is in the Hands of the Man in the Pilot House of the Central Vessel. By "Going Ahead" On One Barge and "Backing" with the Other, It Would Be Entirely Feasible to Turn the Whole Tow Within a Small Circle. 2—This Diagram Illustrates One-half of the Propelling Equipment, An Electric Motor, of a Car Float. 3—A Photograph of the "New Era" Preceding the "DAWN" from Which She Obtained Her Energizing Current. Nearby is Seen the Pulley Over Which the Electrical Conductor Passes and Immediately Below is Visible a Part of the Reel At the Bow of the "DAWN." 4—A Fleet of Electrically Propelled Barges Making Their Way Thru a Canal. It Will Be Observed That the Prime Mover, the Source of Energy, is a Freight-laden Craft At the Rear of the Line.

Now this is pretty much the state of affairs when a tug heads the line of a string of barges or canal boats. Should the convoy be laden, then the tug struggles with all of its power to make headway, but the rate of advance is not in keeping with the speed at which the steamer would move if free and developing the same measure of energy. In short, its task is something akin to a freight locomotive, attached to a train, trying to mount a gradient on wet tracks, but with this difference—the tug must take the water as it finds it, but the locomotive can "sand the rails."

But the towboat is further hampered by the conditions under which it has to work. For instance, its churning propeller drives rearward a veritable mill race—directly against the bows of the oncoming convoy. As a consequence, this disturbance virtually adds to the load to be drawn by turning the steam vessel's own efforts against itself. In these days of high prices and general insistence upon operative efficiency there is a crying need for something better than the tug as a handy marine tractor. Fortunately, a line of improvement has been pointed out and convincingly demonstrated by Mr. William T. Donnelly of New York City.

Mr. Donnelly proposes to turn the erstwhile tug into a navigable *power station*, generating electricity for its own drive and for the unit propulsion of its string of tows. The several vessels that would thus draw upon the floating central station would be equipt with electric motors for driving their respective screws. Making due allowances for the power losses between the generator and the motors dependent upon it, taking into account wastage incidental to transmission, et cetera, Mr. Donnelly has establisht the fact that a given initial power development can be thus apportioned and yield distinctly superior results in the common speed of a nautical train, so to speak. Further, the central station can, with equally good effect, either head or follow its charges or, if desirable, the tows can be secured on one or both sides of the master craft.

To begin with, an arrangement of this nature reasonably promises to add tremendously to the ease with which a number of boats so energized can thread a tortuous channel or a busy waterway, for each unit will be susceptible of independent guidance and, within the limits imposed by the linking electrical conductor, enjoy considerable freedom of action. With each charge properly motored and fitted with a suitable screw for a given maximum speed, and the power boat similarly equipt for efficient operation at towing speeds, the whole string would be able to maintain a pace much faster than that possible if the same propulsive effort were exerted by a tug, as is now the case.

Mr. Donnelly has planned that his system be adapted to coastwise and ocean transportation. In the latter case, while the electric cable would not be expected to exert a pull, still he is satisfied, by reason of technical developments, that the conductor can be built strong enough to permit it to serve as a tow line in an emergency, involving motor breakdown on any of the convoy. For this purpose his cable would be patterned with a copper core suitably insulated, then wrapt with hemp and finally armored with steel wire, the latter giving the needful strength and serving at the same time as a "ground" for the circuit. For deep-sea work, the object in making the distributing cable strong enough to bear a linking stress would be to hold the various units of the tow together during a storm, thus taking care of "lame ducks" and enabling the whole fleet to help one another for the time being, when heading up into the wind and waves.

As a substitute for river freight-and-passenger steamers and kindred craft plying our Great Lakes and semi-protected coastal waters upon daily schedules, Mr. Donnelly would have recourse to specially designed navigable centra stations, capa-

(*Continued on page* 1319)

Talking Over a Sunbeam

By PROF. A. O. RANKINE

Professor of Physics, Imperial College of Science and Technology, London, England.
Written Especially for the Electrical Experimenter.

Fig. 3 Shows the Mount of the Vibrating Mirror On the Phonograph Sound Box. When the Voice Waves are Spoken Into the Trumpet They Cause the Diafram to Vibrate, and Also the Small Mirror Attached On An Arm, Secured to the Center of the Diafram.

FORTY years ago ordinary telephony was a novelty. Today the telephone is part of the equipment of most modern houses, and we use it without often thinking of the ingenuity which resulted in its invention. It comes as a surprise to find that telephony by means of light, the *Photophone*—which is still a great novelty—was invented almost as soon as the ordinary telephone. Appropriately enough, the inventor of both was one and the same person—Alexander Graham Bell. It was in 1880 that he succeeded in communicating speech, by means of a beam of sunlight, over a distance of about 200 yards. This was a very remarkable achievement, and it is difficult to understand why it has failed to be developt to any great extent until recently. Various experimenters have worked intermittently on the subject, with a view to improving Graham Bell's methods, but the fact remains that development has been extraordinarily slow in comparison with that of telephony over wires. The subject is, however, a very fascinating one, and it is the purpose of this article to explain the principles and methods involved.

In ordinary telephony we speak into the transmitter and thereby cause a diafram to vibrate in accordance with the vibrations constituting the speech sounds. The diafram in moving to and fro compresses to a varying degree the carbon granules contained in the microphone. Comprest carbon is a better conductor of electricity than carbon loosely packed, and therefore, if we connect an electric battery to the microphone, we obtain a current of electricity which fluctuates in magnitude in accordance with the vibrations of the diafram. These fluctuations of current are conveyed to a distance *by means of wires*, and, passing thru the electromagnet in the receiver, alter the amount of the attraction which the magnet exerts on an iron diafram, which is thus set in vibration, and the original sounds are reproduced.

Now, it will be clear that *any* means by which we can cause a current of electricity to fluctuate in accordance with the vibrations of speech will provide a method of telephony. And if this current can be operated by means of a beam of light projected from some distance away, it will be possible *to dispense with the wires* between sending and receiving stations. Graham Bell solved this problem by using the remarkable element called *selenium*. This substance is, ordinarily, a bad conductor of electricity, but if it is illuminated by a beam of light, its conductivity is increased. Thus if a thin layer of selenium is connected with an electric battery and kept in the dark, a small current flows thru it. If it is now placed near a bright light, the current is very much increased. Different colors have different effects. Red light is more effective than blue, but, generally speaking, the whole of the constituents of white light contribute to the increased conductivity. It is not within the scope of this article to describe the manufacture of a selenium cell. Suffice it to say that it has to be prepared in a thin layer, annealed at a special temperature, and mounted with two terminals for leading the electric current in and out. It then goes commonly by the name of a "selenium cell." It acts as a sort of electric *valve*, permitting a big current to pass when brightly illuminated, and only a small one when in the dark.

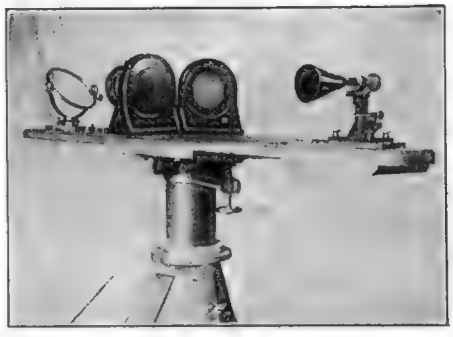
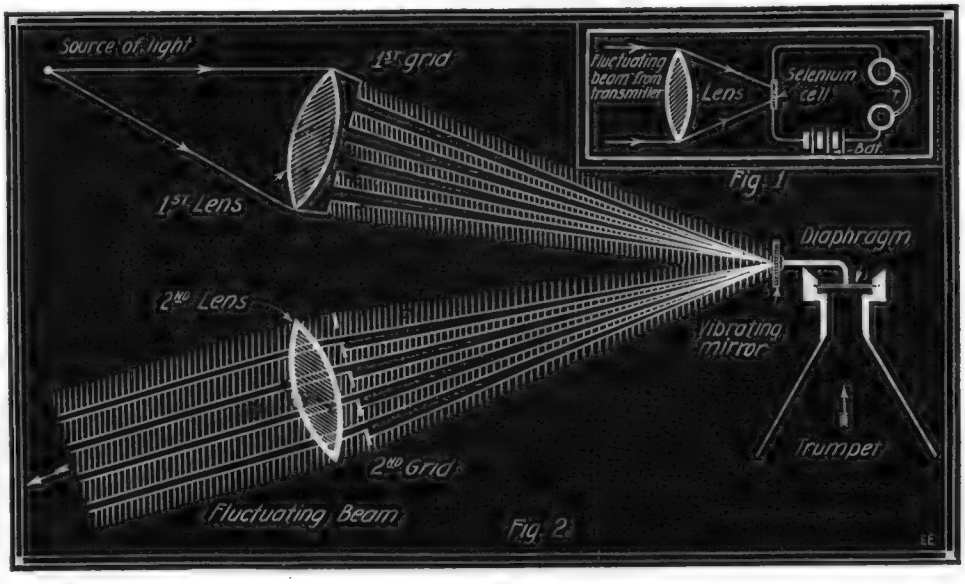


Fig. 4. This Shows the Latest Type Light-ray Transmitter Arranged for Use with Light from the Sun.

Look now at Figure 1. On the right hand side are shown a selenium cell, a battery and a telephone receiver in series. A current is flowing thru the receiver, but it is only when the current fluctuates that sounds will be heard. Now, later on, we shall describe how it is possible to make a beam of light fluctuate in intensity in accordance with the vibrations of speech sounds. For the moment let us suppose we have such a beam and that we focus it by means of the lens on the selenium cell. What will happen? Every time the light gets bright the current in the receiver will increase. Every time it gets dim, there will be a reduction of current. Actually, of course, these fluctuations of light occur far too rapidly to be visible—perhaps 1,000 per second. But the selenium is affected by them, and the variations of light are copied by the variations of current, and one hears, as it were, *the light speaking*. Figure 1 then represents the arrangement of the *receiver* in "telephony by light."



1—Simple Form of Receiving Circuit for Use in Photophone, Comprising Light-sensitive Device, Such as a Selenium Cell, Connected in Series with a Battery and Telephone. 2—This Diagram Shows How Rays from Source of Light are Past Thru a Lens and Grid On to a Vibrating Mirror Mounted On an Arm Attached to a Phonograph Sound-box Diafram at the Right, and How This Beam is Reflected Thru a Second Lens and Grid On Its Way to the Receiving Set.

We have now to consider the problem of the transmitter, that is, the means whereby the vibrations of speech can be imprest upon a beam of light, so as to make it fluctuate accordingly. There are two possible methods of procedure. One may either endeavor to make speech vibrations control the brightness of a source of light itself, or use the vibrations for the purpose of interrupting the light proceeding from a steady source. The latter procedure was adopted by Graham Bell, and he describes two devices in this connection. It is unlikely that the first of these ever proved successful, but it is mentioned here because of its relation to the author's method, which will be described later. Bell proposed to construct two grids consisting of parallel strips alternately opaque and transparent. One of these grids was to be fixt, the other attached to a diafram at the end of a trumpet. The grids were to be placed parallel to one another, and originally so that the opaque strips of the one covered up the spaces of the other. A beam of light fell upon the grids, and the amount of light penetrating the pair would depend on their relative position. By speaking into the trumpet the diafram would be made to vibrate, and, consequently, the "shutter" formed by the grids

(*Continued on page* 1315)

Sawing Ice By "Motor"

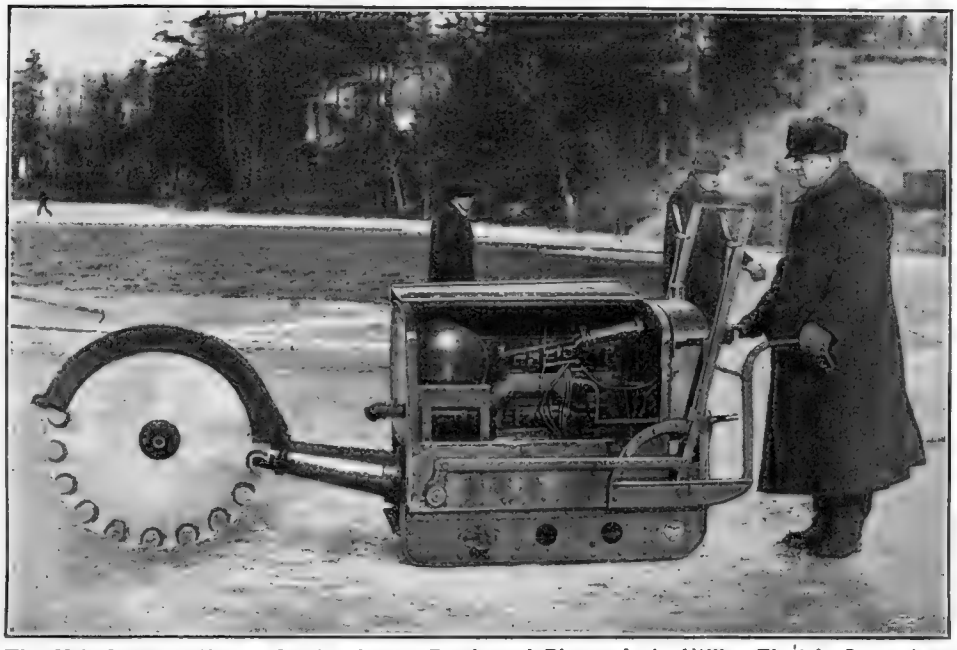
It takes a thief to catch a thief, they say, and so it has finally come to pass that the electric current steps in to really cut ice with anything like efficiency,—or what was once a *current* of water. In other words, this is a case of when current meets current—to paraphrase the old adage "when Greek meets Greek."

The twentieth century way of cutting ice on ponds and rivers, is to utilize electric current to operate a powerful motor, which in turn is connected thru gearing or directly to a large saw which tears thru the ice at prodigious speed.

With the aid of this powerful electric ice sawing machine, which obtains its current thru a flexible insulated cable, running to an electric power line near the pond, the work of putting 60,000 tons of ice in the ice-house of the Boston Ice Co., at Wellesley, Mass., was completed this winter in record-breaking time.

The ice reaches the machine in twenty-foot squares and the four cylinder saws cut them into the regulation size cakes.

Besides the electrically driven saws there are in use many gasoline engine driven saws for ice cutting. A Ford engine makes a good powerful prime mover for such a saw.



The 20th Century Way of Cutting Ice on Ponds and Rivers, Is to Utilize Electric Current as Shown Herewith. The Current Is Transmitted to the Motor Within the Saw Machinery, Thru Flexible Rubber-Covered Cable Running to the Shore. Gasoline Driven Saws Are Also Used.

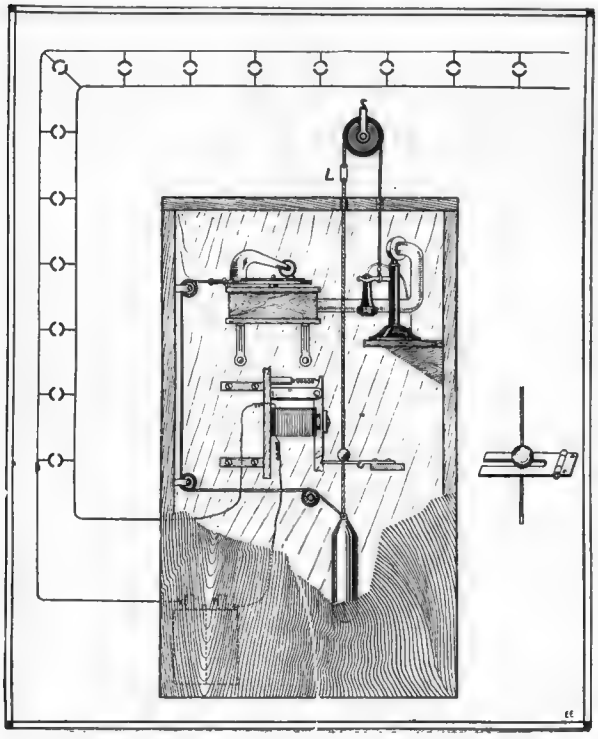
This Fire Alarm "Talks"

NOW that everything in the line of safety apparatus and fire announcers has been invented, a New York genius, a fireman, to be more specific, has perfected and patented a device which not only gives instant alarm in case of fire, but also notifies its precise and exact location, making the announcement when the heat in a room reaches about 130 degrees Fahrenheit, which is considerably lower than the temperature at which the sprinkler system would operate. In this way, announcement of the fire is made long before the automatic sprinklers flood the apartment or building with water, thus ruining by water a lot of material which could have been saved if the sprinkler had been promptly shut off. Knowing the difficulties and the faults of the methods used to-day, the inventor has developed mechanisms which are actuated by weights in which electric current plays but a very small part, and as long as gravity exists the mechanism is absolute and positive in its action.

Fuse links are another feature of this invention. These join together lengths of cord or very thin wire. This taut wire running thru a series of pulleys finally terminates in the fireproof box containing the phonograph apparatus. A weight is suspended to the cord which is also connected directly to the lever starting the phonographic mechanism. Another cord runs up thru the box and has another fuse link inserted in it, the latter outside of the box as illustrated. The cord now passes thru the box again and is connected to the Bell telephone receiver hook.

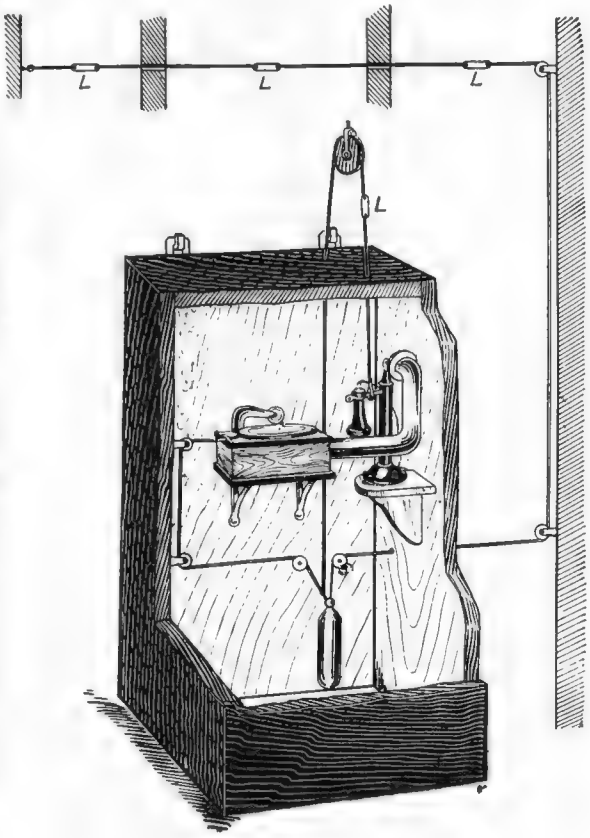
When a fire breaks out in any particular portion of the building, one of the fuses

(*Continued on page* 1317)



"Hello, Operator!—There Is a Fire at 188 Blank Street, In the Warehouse on the Second Floor, Front. Notify Fire Headquarters at York 1,000. Central, there Is . . . Etc." This Is a Fire Alarm Call SPOKEN Over the Telephone by This Latest Fire Alarm Device. Diagram at Right Shows Fusible Links "L" Inserted in Taut Cord Which Releases Phonograph, As Soon As the Links Are Melted.

Diagram at Left Shows Electric Thermostats Which May Be Placed on the Ceiling About 10 Feet Apart, and Electric Relay or Tripping Device for Starting Phonograph In Case of Fire. When the Fusible Link Just Above the Cabinet Melts, the Phonograph Is Shut Off, and the Telephone Hook Is Restored to Normal Condition.



...Automobile News...

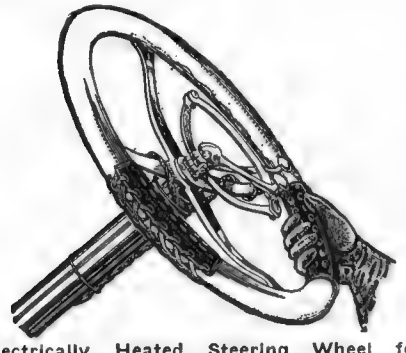
ELECTRIC STEERING WHEEL HEATER.

This newest electric winter driving comfort consists of two neat leather covered grips, one for each hand, which lace on to the steering wheel at any place convenient for driving. Special resistance wires are cleverly arranged between two copper plates in such a way that a very small current is sufficient to keep the grips warm. They operate on the same principle as an electric heating pad. After a certain heat is obtained the heaters will get no hotter, but retain an even temperature. They are simple, neat and efficient.

A type designed specially for the Ford car is heated by electricity from the magneto.

This Is the "Ford" of Europe In the Central Sections. The Power Plant Is Entirely Mounted on the Front Above the Wheel. Photo—Edna Purdy.

Safety demands a firm grip of the steering wheel which you cannot get with cold fingers. The new device keeps your fingers limber, with only a pair of light gauntlets on, which enables you to grip the wheel tight on the coldest winter days, giving you a safe feeling even while driving over pavements slippery with ice.

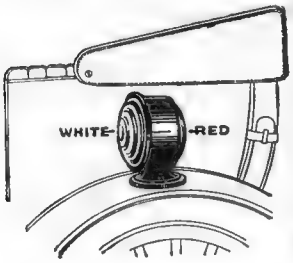


Electrically Heated Steering Wheel for Autos.

The heater coils use only half the current necessary for electric headlights. They are operated from the same storage battery or magneto that supplies the headlights and are easy to attach. They can be put on in ten minutes. There are no bolts or screws, or holes to bore; lace on—wire up—that's all.

AUTO PARKING LIGHT.

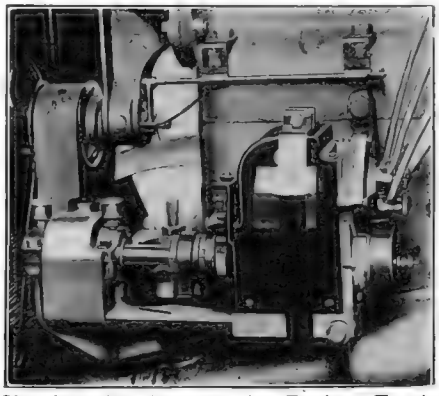
In order to save current while automobiles are standing idle on the streets, an enterprising concern has developed this auto parking light. This lamp is attached to the rear fender and takes the place of the regular head and tail lamps when the car is not being operated. The 2-candle-power bulb is said to consume only about a quarter of the current the regular lamps use. A 2½-inch white semaphore lens is furnished in front of the lamp and a red semaphore lens in the rear. An "off" and "on" switch is installed on the lamp itself.



A Small Current - Saving Electric Parking Light for Autos. Lamp Is Attached to Rear Fender. Flashes White Ahead and Red to Rear.

NEW MAGNETO FOR FORDSON TRACTOR.

One of the neatest and most effective easy-starting ignition appliances yet produced for the Fordson is the new model magneto fitted with an impulse starter coupling. One slow turn of the crank of the engine gives ignition results ordinarily had at 500 revolutions per minute, due to the impulse starter giving a quick spin to the magneto rotor shaft. The new outfit is chain driven from the front end of the crankshaft, the unit being located on the left side of the engine, where it is away from exhaust heat, a most important advantage when the destructive effect of the heat is considered. The heat quickly destroys distributor blocks and reduces the magnetic life of the magnets. In this magneto all this has been eliminated. All that is needed for installation is a wrench. No holes need be drilled, or any parts removed or discarded. As shown in the accompanying illustration, the magneto rests



Showing New Magneto for Fordson Tractor Installed on Engine. It Has an Impulse Starter, Giving Full Spark on One Revolution.

on a support which itself is braced by brackets attached to the crankcase. The instrument is driven by a short shaft at one end of which is an adjustable coupling and at the other two bronze bearings mounted on either side of a 16-tooth sprocket. This sprocket is driven by a silent chain from another sprocket at the forward end of the camshaft. The silent chain is protected by a guard which is provided with an oil hole so that the chain may be given an occasional oiling. The chain is easily adjusted.

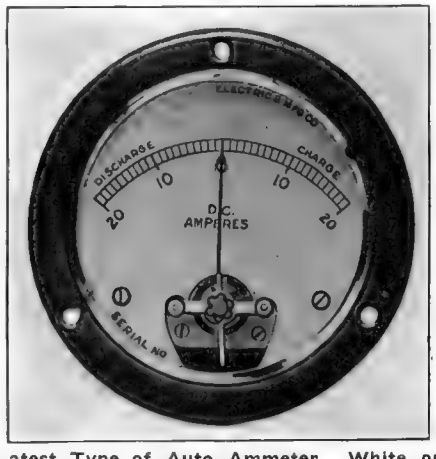
NEW AUTOMOTIVE AMMETERS.

Two new ammeters for automobiles, motor boats, airplanes and other automotives have recently been added to a well-known line of instruments.

The type of ammeter shown is an inexpensive instrument, but is rugged, reliable and amply accurate for the service for which it is intended. It operates on the polarized-vane principle, without springs or moving coils, is dead beat and can withstand momentary overloads of 500 amperes without injury.

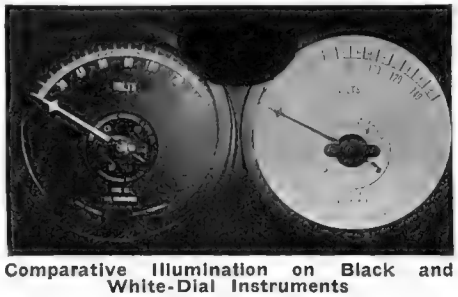
The dial is two inches in diameter, and the scale which indicates amperages of from 15 to 30, charge and discharge, is an inch and a half long. Either black dials with white figures and needles, or white dials with black figures and needles can be supplied. The meter is arranged for flush mounting in the dash or cowl.

The second type of ammeter was originally designed for government radio service, and is the smallest d'Arsonval instrument made. Tho but two inches in body diameter, this instrument possesses all of the delicacy of action, high sensibility, great accuracy and ruggedness of the standard switch-board type. It is supplied for flush as well as projection mounting. Voltmeters with scales ranging from 3 volts upward are also supplied in this style of instrument.



Latest Type of Auto Ammeter. White or Black Dials Are Available on These Meters.

Many electrical instruments can be furnished, when desired, with black dials, the figures, scale, and pointer being white. The comparative illumination on black and white dial instruments is vividly shown by the acompanying illustration, which shows a white and black dial instrument mounted side by side on a switchboard and illuminated by the same lamp.



Comparative Illumination on Black and White-Dial Instruments

Popular Astronomy

By ISABEL M. LEWIS, M. A.
Of the U. S. Naval Observatory

Observing The Heavenly Bodies

TO appreciate the beauties of a starlight night get as far away from the heart of the city as possible. No obobservations of the heavens can be made thru slit-like openings between rows of houses with the glare of street lights in one's face and the smoke, dust and haze of a busy city enveloping one on all sides. Even such celestial jewels as Sirius, Vega and Spica shine with a pale and sickly light for the city dwellers.

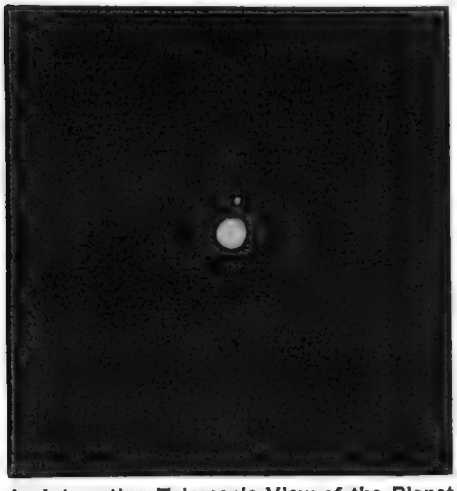
Get out in the open if you want to become acquainted with the stars and choose, moreover, a clear, *moonless* night, for bright moonlight blots out fully half of the stars that would otherwise be visible to the naked eye.

A good test of the "seeing" is the visibility of the Milky Way. If you always view the heavens from the outskirts of a great city the Milky Way really means nothing to you, but if you have the good fortune to be aboard ship on a clear, dark, moonless night or on the western prairies or near the summit of a mountain or at some farm or country home far removed from the city you will not fail to see at some hour of the night a portion of this magnificent girdle of the heavens, the groundwork of the universe, where suns are piled upon suns in riotous profusion and where the misty light of the luminous nebulae leads into the dark caves, rifts and lanes produced by the non-luminous nebulae, the whole giving us the impression of an elaborate and intricate structure that reveals the workings of a Master-mind and overwhelms us with feelings of awe.

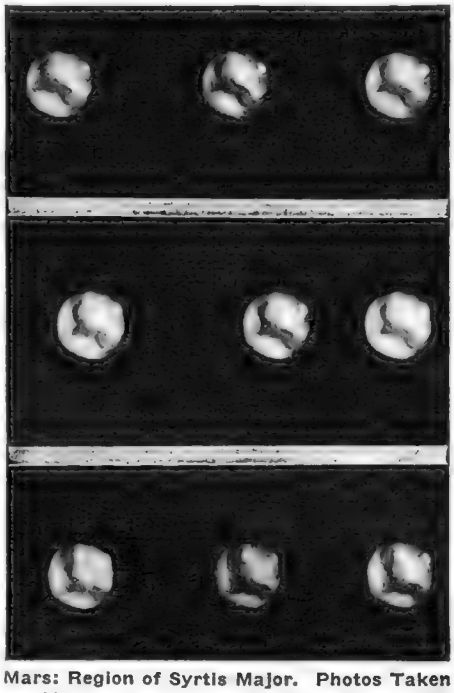
In attempting to explore the wonders of the heavens with an opera-glass some amateurs have complained that they could not find Jupiter's four moons. This may be due either to poor observing conditions, as mentioned above, or to the use of a poor glass or to failure to recognize these minute points of light when visible. All four moons will probably not be visible at once, as one or more of the moons will usually be in transit across the planet or occulted behind the planet or eclipsed by its shadow.

Continued observing from night to night will reveal the fact that these little bodies are actually revolving around the plant.

With a telescope that was in some respects inferior to a modern field glass Galileo determined the periods of revolution of all four satellites within a few nights of their discovery.



An Interesting Telescopic View of the Planet Neptune with Its Moon. The Little White Spot Near the Large One Is Neptune's Moon. An Unusual Photograph, as the Little Satellite Is a Very Difficult Object to View, Even Thru a Large Telescope.



Mars: Region of Syrtis Major. Photos Taken at Yerkes, September 28, 1909, Showing Changes Due to Rotation. Exposure 3 to 4 Seconds.

Some have complained also of the "dancing" of the stars when viewed thru a spyglass or small telescope of greater power than an ordinary field glass. It is useless to attempt to use any instrument more powerful than a field glass or opera glass without a tripod or rigid mounting of some form.

The more powerful the telescope the more carefully it must be mounted.

Buildings for housing powerful telescopes are built, if possible, far away from streetcar lines and railroads for the trembling of the ground caused by the passage of trains and cars affects the instruments. Telescopes of four inches or more in aperture are of little value unless mounted on a stone or cement pier and housed in such a way as to be entirely free of the floor, as even walking across the floor would otherwise cause the instruments to tremble. Temperature and atmospheric effects must also be considered, and to equalize the inside and outside temperature and overcome the "boiling" of the atmosphere due to unequal temperature the astronomer throws open the dome of the observing room for some time before he expects to begin his observations.

At most large observatories "visitors' nights" are a regular feature. Visitors to Mt. Wilson Observatory observe the great 100-inch reflector from a glass encased observing room that they may introduce no temperature effects upon the sensitiveness of this powerful instrument.

There are certain celestial objects that nearly every one desires to see thru a telescope.

We all want to see the Moon and Saturn's rings and some of our near neighbors in the solar system, as well as some of the most interesting objects that lie many light years away, the great nebulae and the globular star clusters and the double stars.

The best general view of the moon, as many are aware, is obtained a few days after the first quarter, but the best time to study any particular marking is when it lies near the terminator, the line separating the light from the dark portion of the moon's surface. The marking, crater or mountain or cleft, as the case may be, is then illuminated by a low sun and casts a long shadow, which indicates the height and form of the object. Lunar objects that stand forth beautifully when the sun is rising or setting upon them sometimes entirely disappear from view under a high sun. The poorest of all times to observe the moon is at the time of full moon, when there are no shadows and all detail of the lunar markings is lost in a flood of sunlight under vertical illumination.

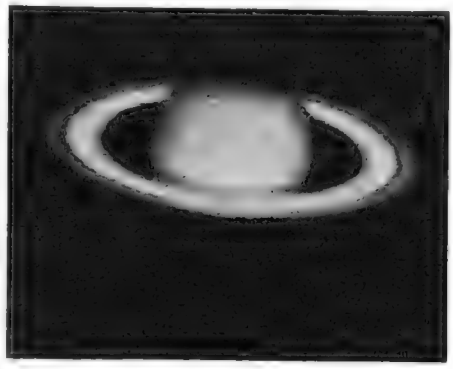
The most interesting views of the moon from a popular point of view are those obtained with a six- or eight-inch telescope showing the entire lunar disk in the field of view.

Highly magnified views taken with the great reflectors and refractors show the moon to us piece-meal, for, as the magnification increases, the angular width of the field decreases, and instead of a view of the entire lunar disk we get a "close-up" of a very limited portion of the surface showing great detail.

Venus in the telescope is a surprisingly beautiful little object if seen near its time of greatest brilliancy, halfway between inferior conjunction and elongation, when it appears as an exquisite little crescent moon. With a magnifying power of forty-five Venus appears exactly as the moon does to the unaided eye when it is four days old, tho, of course, it shows no distinctive markings such as appear on the lunar surface, for the surface of Venus is screened from our view by its dense atmosphere.

Astronomers prefer to make their observations of Venus and Mercury in the daytime, for they are then higher in the sky and the observations are not marred by the disturbing atmospheric effects of refraction, haze and "boiling" that are always greatest near the horizon.

Saturn is one celestial object that hardly ever disappoints us. His rings are a source of never-failing interest to everyone. To be sure, they disappear from view for a very brief period once every fifteen or seventeen years, when our line of vision

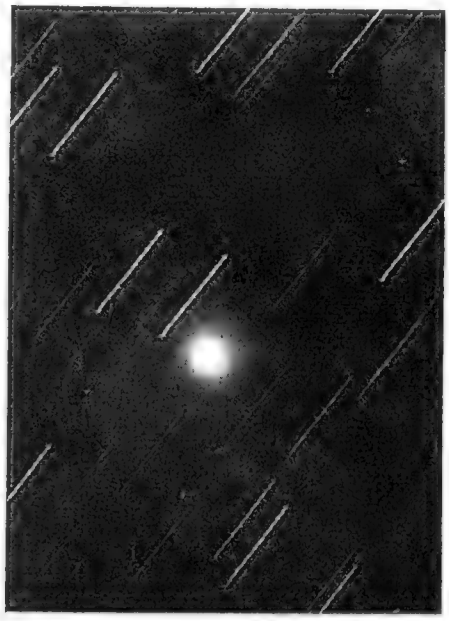


Remarkable Photograph of Saturn, Taken November 17, 1911, with the Sixty Inch Telescope of the Mt. Wilson Observatory. This Shows It as It Appears in a Powerful Reflecting Telescope.

lies directly in their plane, but such disappearances are comparatively rare and, even at such times, we cannot fail to be in-

At Left—Great Photographic Nebula Near Pi and Delta Scorpii. Photographed by Mr. Barnard with the Bruce Telescope. Exposure 8 Hours and 45 Minutes. One of the Most Beautiful Sights in the Heavens.

At Right—Encke's Comet, Taken at the Yerkes Observatory, October 29, 1914. Note the Great Lengths of the Star Trails, Which Indicate Rapid Motion of the Comet. This Comet Is Noted for Having the Shortest Period of All Known Periodic Comets, Three and Three-Tenths Years. At Its Brightest, It Is a Faint Telescopic Object, Showing no Trail.



terested in his belts and his moons and the pronounced flattening at the poles, which is then particularly noticeable.

Jupiter also delights us all with his constantly changing belts and varied coloring, and the phenomena of his four historic moons that show up so beautifully even in the small telescopes.

Mars in the telescope is usually a disappointment to every one, and the astronomer never presents him as a show object; in fact, he prefers not to show him at all unless you are prepared beforehand. The Martian disk is small, for Mars is a tiny world after all. Its surface is less than a third that of the earth, it must be remembered. To glimpse the Martian canals one needs a trained eye and the skill in observing that only comes after long continued practise, as well as exceptionally fine atmospheric conditions, such as are not usually to be found on visitors' nights at the observatories of our large cities.

It must be remembered that the maps of the Martian canals that most of us have seen are the results of years of painstaking observations made under superlatively fine observing conditions, and that only a small proportion of the total number of canals have been seen at any one time. A canal may flash forth during a moment of exceptional seeing and then be dimmed by Martian mists or terrestrial haze. Even the chance observer will note the snow caps, however, and the most conspicuous surface markings.

The outer planets, Uranus and Neptune, are so far away that they are of little interest even in the large telescopes.

In delving into space beyond the solar system, of greatest interest to all are the star clusters and nebulae and the double and multiple star systems, as well as the many wonderful regions of the Milky Way.

Aside from the Great Nebula in Orion, which is, indeed, a wonderful object in the telescope, the nebulae are, on the whole, disappointing when observed directly. Here is one instance in which the photographic plate, on account of the *cumulative effect of light*, is vastly superior to the human eye. All the wonderful detail brought out in the photographs of the nebulae and star-clusters is the result of *several hours of photographic exposure.*

The Great Spiral Nebula in Andromeda, the Trifid Nebula and many of the wonderful double armed spirals with which we are familiar thru their photographs show up quite disappointingly in the telescope because they appear so extremely faint to the human eye.

Star clusters, as well as nebulae, appear at their best photographically. A few of the coarser globular clusters are wonderful objects in the larger telescopes. With small three-inch telescopes it is difficult to make out the stellar nature of even the coarsest of the star clusters.

Double and multiple star-systems can always be found even with as modest an instrument as an opera glass, for these systems abound in the heavens. At a conservative estimate at least one out of every four stars belongs to a physically connected system composed of two or more stars revolving around a common center of gravity.

One of the tests of the power of a telescope is its ability to separate close double stars. A six-inch telescope will separate a double star into its two components that appears as a single star in a three- or four-inch telescope, while it will in turn show as a single star a close double that can be separated by a telescope of greater aperture.

Some double stars are so close that no existing telescope is powerful enough to separate them, tho the shifting of spectral lines will reveal that a companion star is present. Such double star systems are called *spectroscopic binaries.*

The wider doubles are frequently of beautifully contrasting colors, such as green and red or blue and gold. Many of these gems are visible in the smallest telescopes and they are among the wonders of the heavens that every one will want to see.

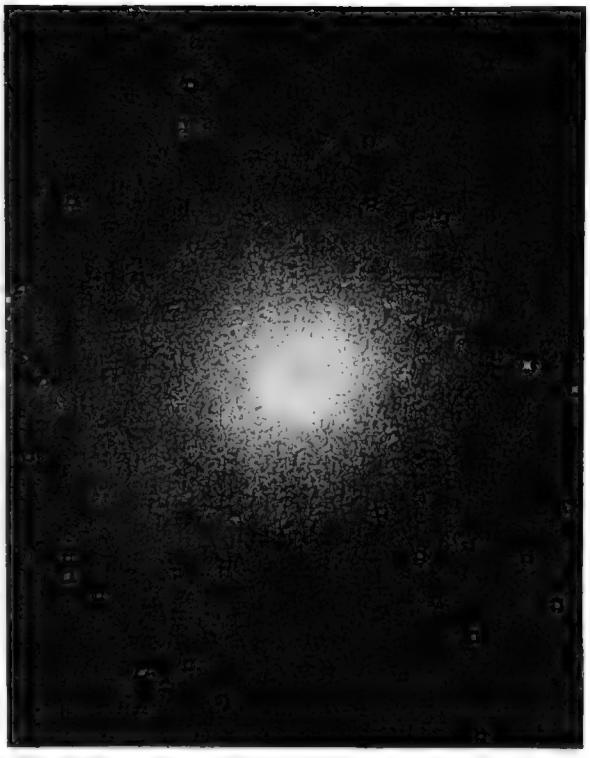
Often the faint companion of a brilliant star will be invisible in small telescopes because of the glare of light from its bright companion. Such is the case with the companions of Rigel and Antares.

Close satellites of the planets Jupiter, Saturn and Mars are also difficult to find, not only because they are small, but because they must always be so close to the planet that they are dimmed by its light. For the same reason our terrestrial planets are invisible at the distance of the outer planets.

Comets are not interesting objects to view telescopically, as they are extremely faint. No extended surface, such as the disk of a planet or a comet can appear brighter telescopically than it does to the naked

One of the Most Interesting of All Comets (Morehouse Comet) Because of the Sudden and Unexplainable Changes In Form and Brightness That Were Continually Taking Place. The Telescope Was Kept Pointed on the Comet While the Photograph Was Being Taken, Which Caused the Star Images to Trail Across the Plate. Taken at the Yerkes Observatory, October 15, 1908.

At Left—The Bruce Telescope of the Yerkes Observatory, Showing the Three Objectives by Means of Which Different Sized Photographs of the Same Regions May Be Photographed Simultaneously. Magnificent Photographs of the "Milky Way" Were Taken by Mr. Barnard with This Instrument, Temporarily Located on Mount Wilson, Cal. The Plate Holders Are Placed at the Eye-End of the Telescope.



At Right—A Universe of Suns: The Great Star Cluster in Hercules (Messier 13). Distance from the Earth Estimated To Be 37,000 Light Years. Photographed with the Sixty-foot Reflector of the Mt. Wilson Observatory. Exposure 11 Hours. This Is Visible to the Naked Eye as a Faint, Hazy Patch of Light. In a Three-Inch Telescope, Its Stellar Nature Can Hardly Be Distinguished.

eye, for altho the increase in light is proportional to the square of the diameter of the lens, the magnification of the object by the eyepiece spreads this light over a greater surface and the total amount of light received by the eye is less than when the object is gazed at directly.

The total amount of light received from the *stars*, however, is greatly increased as the diameter of the lens increases, because they appear as points of light. The bright stars can be seen in the daytime in the telescope and millions upon millions of stars invisible to the naked eye can be seen in the telescope. Many more millions that cannot be seen by the eye, even with telescopic aid, can be brought out by the cumulative action of light upon the photographic plate.

Photography is of little value in studying in detail surface markings of the planets on account of the rotation of the planets on their axes, which makes long photographic exposures impracticable.

The Martian canals have lately been photographed at the Lowell Observatory, and Dr. Slipher's wonderful photographs of Jupiter give unsurpassed general views of the Jovian markings, but all the more delicate changes in tint and shade of the markings of Jupiter, Saturn and Mars and, in fact, of the lunar markings as well, can be caught only by the human eye, which excels the photographic plate in catching *fleeting glimpses of fine detail* and in utilizing the rare instants of *perfect seeing* which occur from time to time in all localities.

Photography is far more valuable for cometary work than in delineating planetary features.

In spite of the fact that a comet is moving rapidly thru the solar system, valuable photographic exposures of even several hours' duration can be obtained by stopping the clockwork of the telescope, which keeps the stars immovable in the field, and allowing the stars to trail across the field while an observer keeps the telescope pointed on the comet thruout the time of exposure by means of the cross-wires in the finder of the telescope or by some similar means.

Wonderful photographs of comets have been obtained by such methods and these are of great scientific value in that they afford indisputable evidence of the changes in the form and general appearance of a comet that often take place with startling suddenness.

The speed with which the comet is moving can be judged from the length of the star trails produced during the exposure.

Photographs of comets are of great value to any one interested in researches into the causes of the remarkable and unaccountable changes in the behavior of comets that are continually occurring.

One of the most interesting of all comets was Comet Morehouse (1908), which, tho never bright, exhibited some very striking phenomena. Its brightness changed from time to time in a most erratic manner, and the material that formed the tail at times appeared to be swept aside by unseen forces or driven from the head with unaccountable rapidity. It may be considered one of the most mysterious comets that has ever appeared. Many excellent photographs of this comet were taken which prove the peculiarity of its behavior.

Of special interest this spring will be the apposition of Mars, which will occur on April 21. Mars' nearest approach to the earth will take place a few days later, on April 27, when it will be about fifty-four million miles from the earth. In 1922 and 1924 the distance will be even less.

Any one may find the ruddy-hued planet at that time very readily, as it will be the brightest red star in view in the evening. At the time of apposition Mars will be almost as bright as Sirius, the brightest star in the sky, which will disappear below the western horizon very early in the evening by the last of April. At the same time Mars will appear in the eastern sky shortly after sunset and will be on the meridian at midnight. Jupiter will also be seen just west of the meridian at sunset and will not set until after midnight.

Sir Ernest Rutherford, On The Problems Of Radioactivity

In the first Silvanus Thompson Memorial Lecture, delivered before the Röntgen Society Sir Ernest Rutherford, F. R. S., reviewed the various lines of scientific investigation opened up as a result of the discovery of X-rays. In a tribute to the first president of the society, in whose honor the lectureship was instituted, he mentioned that on the morning that the late Silvanus Thompson read of Röntgen's discovery he set to work, and by nightfall had succeeded in producing what was probably the first X-ray photograph taken in England. The outbreak of war, Professor Rutherford said, had caused an almost complete stoppage in the great tide of advance in pure science, but the lull afforded a suitable opportunity for looking back with some degree of perspective over the ground covered during the last twenty years.

Undoubtedly the discovery of this new type of radiation marked the beginning of an epoch in physical science and had brought about a revolution in ideas of the nature of matter and electricity almost as marked as that produced in biology by the theory of evolution. The two decades from 1895 to 1915 had been a period of pioneer advance over a new and fertile territory, with the almost daily discovery of interesting facts and the gradual unfolding of fundamental ideas. The directions of advance which had been stimulated by the discovery of X-rays included investigation on the ionization of gases, electrons, the diffraction of X-rays by crystals, and, most important of all, the phenomena of radioactivity, which was an even more direct consequence of the discovery of X-rays than the work on the electron. The sequence of changes in uranium, thorium, and actinium had now been followed out, not, indeed completely, but in the main part. No doubt there would still be in the future considerable developments as the result of investigations of the multiple transformations of the atom, but as a whole, apart from a few outstanding difficulties, like the origin of actinium, the transformation of radioactive bodies was fairly well understood.

"Rabbit Contest" Awards

(CONTINUED FROM THE MARCH NUMBER)

SECOND HONORABLE MENTION.

I wish to say that the peculiar effect reproduced on the sample piece of film publisht in the December issue of the ELECTRICAL EXPERIMENTER was probably caused by the distorted curve of the primary alternating current which was probably operating at commercial frequency.

A distorted curve is considered as a resultant of a sine curve of the same frequency as the distorted curve, combined with a number of other sine curves of a higher frequency. The shape of the resultant curve depends on the features of design of the circuit. The sine wave of the same frequency as the distorted wave is called the *fundamental wave,* and the higher frequency components are called *harmonics.* Practically the resultant of the fundamental and a limited number of harmonics will represent any distorted wave with sufficient accuracy.

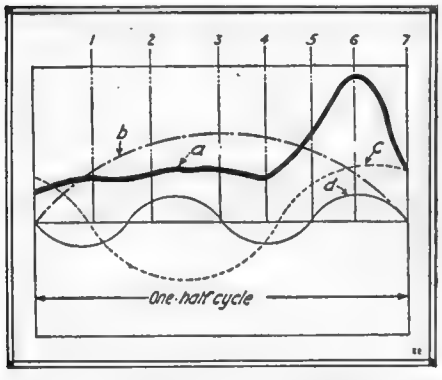


Diagram to Accompany Mr. Coffman's Explanation of the "Mysterious Rabbit."

The actual shape of curves is determined by means of an oscillograph or by some other method. In practice the problem is usually that of splitting up a given distorted curve into the fundamental and harmonics, and the ability to distinguish at a glance the presence of prominent harmonics in any distorted curve can be attained only by practice in drawing different fundamental waves and harmonics and adding these algebraically. In making such drawings the maximum value of the harmonics should be taken at less than the maximum value of the fundamental.

By referring to the photo of the film, we may draw a resultant curve which will be distorted as can be seen. The resultant curve is shown in the illustration. By beginning at the top of the film and going down it can be seen that the power of the primary inducing current gradually increased, and then suddenly flasht up to maximum power when view six was taken. The numerals in the accompanying illustration represent the time at which the respective views were taken. By analyzation of the resultant curves, it is proven that it consists of the fundamental wave *b* and the second and fourth harmonics *c* and *d,* respectively.

Altho the current in the high frequency secondary circuit was oscillating at an extremely high frequency, compared with that in the primary circuit, the power of the same at any instant was dependant upon the power of the current in the primary at that instant.

RAYMOND NOBLE COFFMAN.

105 Burt Ave.,
Newark, Ohio.

THIRD HONORABLE MENTION.

The effect obtained in making motion pictures of the rabbit undergoing the corona discharge from a high frequency apparatus is due to the fact that the exposures are made without reference to the intermittent appearance and disappearance of the corona discharge.

In a high frequency set the secondary voltage and current rises to maximum and drops to zero value in a rapidly succeeding train of high frequency waves for each discharge of the primary spark gap. That is, the frequency may be 200,000 cycles per second, but these wave trains are split into groups with a wave envelope of a shape determined by the frequency of sparking and the damping in the circuits.

A motion picture camera operating at a rate of sixteen exposures per second with each exposure lasting, say, .01 second, will snap the corona in the different stages of its changing values. The first five exposures on the length of film were made when the corona was at a value below its maximum, the sixth exposure occurring at the exact instant it had reached its maximum value in one of its recurring cycles. Were the rate of exposure and spark discharge kept at the same rate a perfect picture would be obtained at regular intervals.

THOS. W. BENSON.

3722 M St.,
Philadelphia, Pa.

FOURTH HONORABLE MENTION.

To explain this strange phenomenon, it is assumed that the spark-discharge used was of a highly dampt order, also the speed of the camera at the time happened to be running at a speed, synchronous to one of the many harmonics of a wavelength developt by the frequency of the spark discharge.

If this be true, then each picture, beginning at the top would not necessarily be taken of the next wave of the train, but the next in their order of the harmonic.

It must be understood that the harmonic is moving constantly with the frequency of the wavelength developt by the spark discharge.

In this case the camera shutter opens only when the harmonic is in evidence; that is, there is no picture taken except when the harmonic covers some one point of the discharge wave-train.

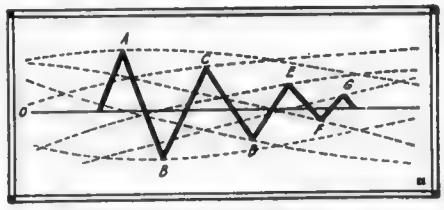
To illustrate this, the full lines in the drawing show the oscillations of only one spark discharge, and the broken lines show the harmonic position relative to the opening of the camera shutter on a spark discharge, that is, the first picture in the illustration would be taken when the harmonic was in a position as shown at C in the drawing, the second taken when the harmonic again crost a wave-train or at a point D, the third at a point E, the fourth at a point F, the fifth at a point G, the sixth picture would be taken from the first rush of current in discharging or at a point A, the seventh and eighth would be taken at a point G also or even later if the time-length of the wave-train was greater.

I have made many photographs of spark discharges, sometimes obtaining no picture at all, and never any two of the same strength or density.

By using a speed camera with a shutter speed of one, three or four hundredths of a second, pictures of this nature are easily obtained.

The movie camera gives the same effect, except that there are sixteen pictures per second in the standard machine, therefore the camera must have been running at a speed synchronous to a harmonic wavelength developt when the discharge took place.

HAROLD C. SIMONS,
Elec. (R. O.) U. S. N.,
Frankford, Mich.



Harmonics Enter Into the Solution of the "Rabbit Puzzle" by Mr. Simons.

FIFTH HONORABLE MENTION.

As everyone knows who is familiar with alternating current on open circuit (such as the poles and secondary windings of an high frequency induction coil constitute) the poles are electrified alternately with charges of positive and negative sign, one pole being positive while the other is negative. With a frequency of two hundred thousand the change in sign of the charge of either pole occurs so rapidly that the discharge seems to the unaided eye to be continuous.

The fact of the matter is that the discharge is not continuous, but approaches a maximum as the pole under observation is charged with electricity of one sign at its highest potential; dies down and disappears with the lowering of this potential, only to reappear when the pole is almost immediately charged with electricity of the opposite sign at a rising potential.

Thus it will be seen that if a camera with a fast working speed were trained upon the rabbit (in this case constituting part of one pole of the machine) and the film exposed at the time that the electric charge was changing signs (that is, when there is no discharge), the film when developt would be blank, while if exposed at the time of maximum discharge the result would be as shown in picture number six.

As the moving picture camera has a "frequency" of *approximately* sixteen, and the electrical discharge a frequency of two hundred thousand, the exposures would be made at times of different degrees of discharge.

Thus exposure number one was made when the discharge was approaching a minimum. Number two was made as the potential of the charge was still lower than the potential of the charge photographed in number one; numbers three and four are photographs of receding potential, while in number five the exposures of the camera and the frequency of the electrical machine again commence to be in synchronism, and the result is that the sixth exposure was made just as the discharge was at its maximum brilliancy, while numbers seven and eight again were made at times of discharge of lower potential.

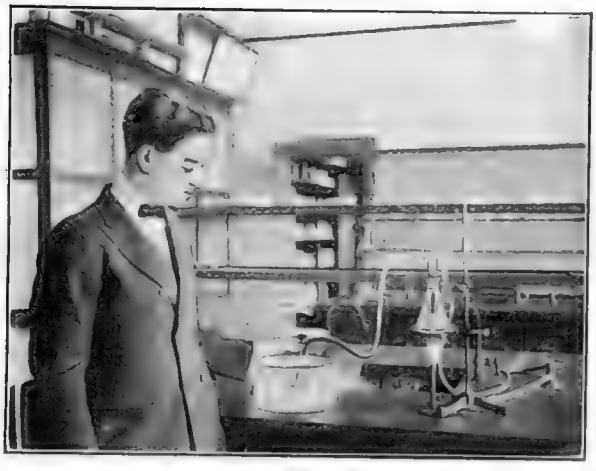
FRANK L. HEYDON.

Ponca, Neb.

(*Continued on page* 1317)

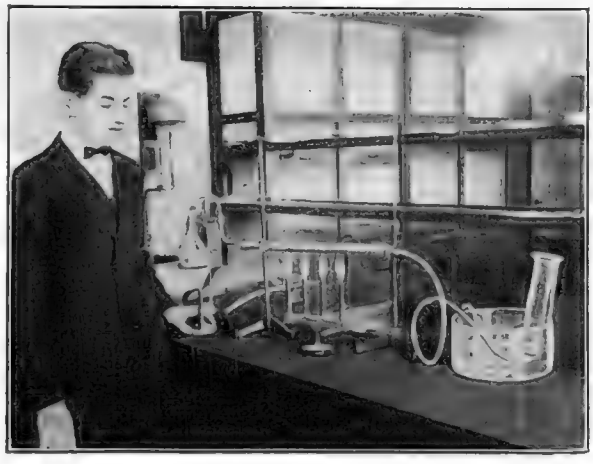
Practical Chemical Experiments

By PROF. FLOYD L. DARROW



Left — Making Phosphine Rings Is an Extremely Interesting "Chemical Stunt," Which Will Please All Those Who Have Even a Small Laboratory. The Gas Rings Arise in the Form of Beautiful Concentric Circles.

Right — Generation of Water Gas Is Here Readily Demonstrated, the Gas Being Collected by Downward Water Displacement. Note Bunsen Burner Quartet. The Set-Up of the Apparatus Is Clearly Depicted in Diagram, Figure 11.



FLAMES AND ILLUMINANTS.

THE object of experimentation in the home laboratory should not be amusement, merely. If that were the sole purpose, it would not be worth the time and effort required. But the skill in manipulation, the knowledge of chemistry, the training in observation and the interest in scientific work acquired in such practice are of inestimable value. It is well to remember, too, that a century and a half ago when chemistry was in its infancy most of the great chemical discoveries were made in *home laboratories*. Therefore, in all the work make it the best possible, be sure you understand the chemistry back of it and seek at every point to gain increased skill in manipulation.

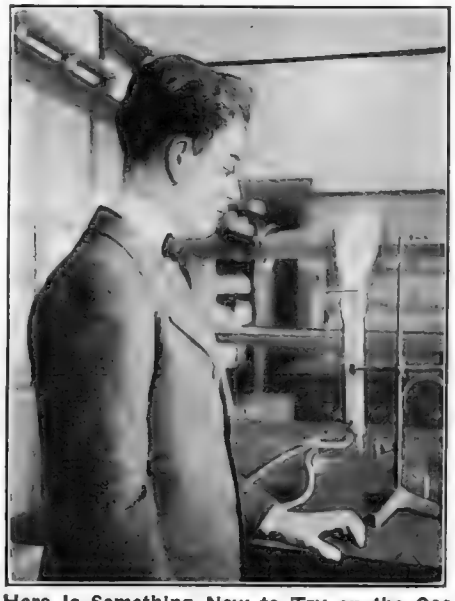
In this article we shall consider the chemistry of *flames and illuminants*—a most important field of chemical investigation. Perhaps, we had better start off with the fact that to produce a flame requires the union of two gases or vapors. Red hot coals glow but there is no flame. Likewise the burning of iron in oxygen or the union of sulfur and zinc dust produces light but no flame.

An Extremely Simple Acetylene Gas Lamp Whereby the Amateur Chemist Can Work at Night. The Light Emitted Is Very Constant and the Lamp May Be Turned Off by Simply Tightening the Pinch-Cock. The Embryo Chemist Is Here Seen Carrying on an Analysis Experiment by the Acetylene Lamp.

IGNITION OF GAS FROM AN EXTINGUISHED CANDLE.

Light a candle and when it is burning well blow out the flame. Immediately hold a lighted match in the rising smoke a half inch above the wick, when the vapor will catch fire and running back will communicate the flame to the wick.

To show this on a larger scale arrange a candle and Argand lamp chimney as shown in figure 1 allowing for good ventilation. On blowing out the flame and applying the lighted match to the top of the chimney, the candle will be relighted. The chimney may be 3 or 4 inches in height.



Here Is Something New to Try on the Gas Company. Instead of Burning Gas in Air—Do Both; Burn Air in Gas and Gas in Air Simultaneously, Thus Obtaining Two Lights at the Cost of One. The Trick Lies in the Lighting and Piping Arrangements of the Apparatus.

TO ILLUSTRATE THE TERM "SUPPORTER OF COMBUSTION."

A gas may be combustible and yet not a supporter of combustion. This is well illustrated with hydrogen. Generate a cylinder of the gas in the usual way by the action of dilute sulfuric on zinc and collect the gas over water.

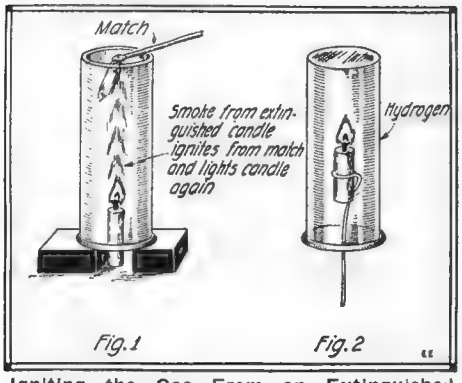
Now as shown in figure 2 hold the cylinder of hydrogen in the left hand, mouth downward and thrust upward into it a lighted candle attached to a wire. The hydrogen lights at the mouth of the cylinder with a small explosion, burning with an almost colorless flame, but the candle immediately goes out. Upon withdrawing the candle it is relighted at the mouth, showing that the hydrogen itself is burning. The operation may be repeated a number of times before the gas is exhausted. This shows clearly that while the hydrogen is combustible it does not support combustion. This is also true of many other gases.

BURNING AIR.

That either illuminating gas or air may be regarded as the supporter of combustion is shown by the following experiment:

Fit a lamp chimney with a 2-holed rubber stopper carrying a glass elbow and a straight glass tube as shown in figure 3. The straight tube should be about 10 millimeters in diameter. On the top of the chimney place a piece of asbestos board with a small hole in the center. Now connect the glass elbow with the gas supply and closing the hole in the asbestos board with the palm of the hand turn on the

The Gas Flame Above Shown Coming From the Bottle Is Due to the Fact That Gas Had Been Introduced Primarily and Later Shut Off. Air Mixes With the Gas in the Bottle Until Finally the Mixture Therein Contained Is of a Sufficient Explosive Context to Go Off With a Loud Report.



Igniting the Gas From an Extinguished Candle, Thus Lighting the Candle Again.

Above, Diagram Showing That Even Those Gases Which Burn Can Act as Supporters of Combustion in Which Case They Need Not Burn.

gas. Then light the gas at the lower end of the straight tube, immediately remove your hand from the cardboard and also light the gas at the top of the chimney. Two flames will result, one at the top of the chimney, which is the excess of gas burning in air and the other at the top of the straight tube, which is air burning in an atmosphere of illuminating gas. Thus air is the combustible gas here and the illuminating gas is the supporter of combustion.

AN EXPLOSIVE MIXTURE.

Secure a 2-holed Woolf bottle of two or three liters capacity and fit the necks with stoppers carrying glass tubes as shown in Figure 4. The straight tube should be about 10 or 12 millimeters in diameter. Connect the glass elbow with a gas cock, and turning on the gas drive out the air from the bottle. Light the gas at the top of the straight tube and then withdraw the elbow with its stopper, at the same time turning off the gas. The flame will continue to burn at the top of the straight tube for a few minutes and then seem to disappear entirely. But do not conclude that nothing will happen. Wait, and suddenly a sharp report will occur and the bottle will be filled with a sheet of flame. In a *darkened room* the effect is much more impressive.

As the burning gas escapes, air enters thru the open neck until the bottle is full of an *explosive mixture* of gas and air, when the feeble flame strikes down into the mixture and ignites it. The "striking back" of a gas stove or Bunsen burner is due to the same cause.

THE SAFETY LAMP.

Multiply the above explosion a million times and you will have something like the effect produced by an explosion of "fire damp" in a coal mine. It will show you, too, the necessity for the miner's safety lamp invented by Sir Humphrey Davy a century ago.

The principle of this lamp is well shown by surrounding a candle with a cylinder of fine iron or copper gauze. Cut a sheet of gauze 6 by 8 inches and roll it into a cylinder and fasten it along the edges. At the bottom place a candle, securing it in position with wire supports.

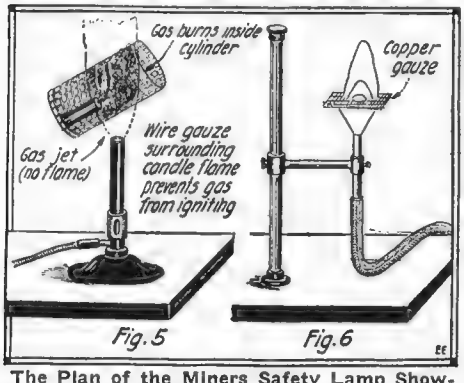
Light the candle and hold the cylinder horizontally in jet of illuminating gas as shown in figure 5. The gas will be seen to burn inside the cylinder but the flame will not communicate outside and the burner will not light. This gauze may even become red hot without igniting the gas on the outside. So good a conductor of heat is the gauze that the gas does not reach its kindling temperature. A simple application of a physical principle, and yet it has saved thousands of lives.

A BUNSEN BURNER FLAME.

With the air holes open at the bottom of the tube a Bunsen burner flame shows two distinct cones—an outer cone of burning gas called the "oxidizing" flame and an inner cone of unburned gas called the "reducing" flame.

That the inner cone is not undergoing combustion is very strikingly shown in the following way: Thrust a pin thru a match stick about a half inch below the head. Mount this in the top of a Bunsen burner and turn on the gas. Now light the gas and observe that the match does not burn. To show that it has not burned turn off the gas and it will be found that the match is perfectly good and can be lighted in the usual way.

Another very striking experiment to demonstrate this fact is illustrated in figure 6. Make a burner of a small glass funnel and over the top place a piece of fine copper gauze. In the center of the gauze place a small heap of gunpowder or flashlight powder. Turn on the gas and light it by bringing a match down from above. The gas will burn but the powder will remain unignited. Slowly turn off the gas and as the flame diminishes in size the powder will ignite.

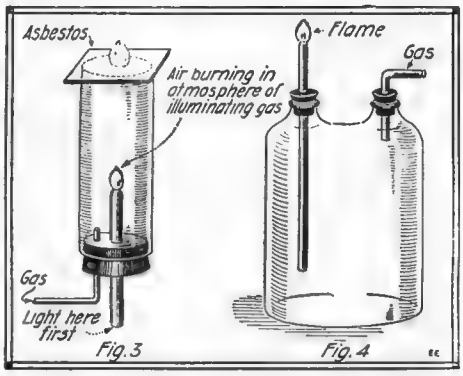


The Plan of the Miners Safety Lamp Showing That an Explosive or Dangerous Gas Will Burn Inside the Wire Gauze Cage, Yet Not Ignite the Atmosphere of Gas Surrounding It.

Demonstrating That the Inner Cone of the Bunsen Flame Is Cool.

SPONTANEOUS IGNITION OF HYDROGEN.

Direct a stream of hydrogen from a generator on some platinized asbestos, when the asbestos will be seen to glow and presently the hydrogen will ignite.



Burning Air in an Atmosphere of Illuminating Gas. Two Lights are Noticed, One at the Top of the Cylinder Burning in Air, the Other Inside the Cylinder Burning in an Atmosphere of Gas.

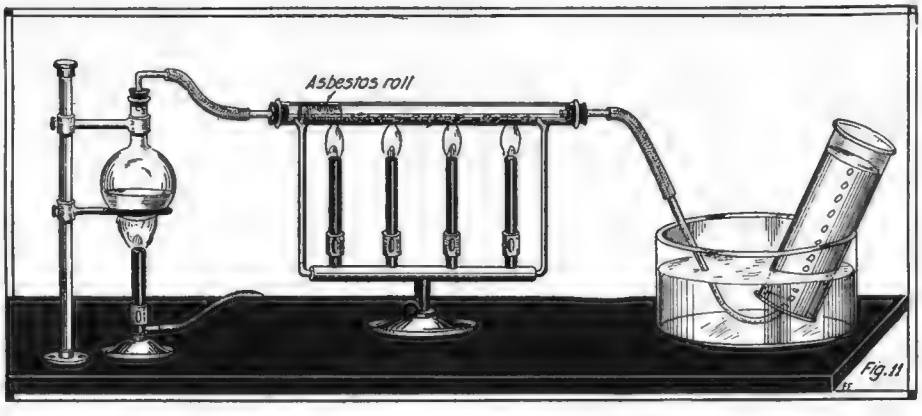
The Layout for the Explosive Mixture Experiment. The Gas Supply Pipe and Cork is Removed; the Flame, However, Still Continues to Burn. Why?

The platinized asbestos may be prepared by moistening a small quantity of asbestos fibers with a few drops of platinum chlorid solution and igniting them in a Bunsen burner flame. The chlorid decomposes and finally divided platinum is left on the fibers.

PHOSPHINE SMOKE RINGS.

Arrange apparatus as shown in Figure 7. Fit a flask with a 2-holed stopper carrying two bent tubes, one of which reaches nearly to the bottom of the flask. In the flask place a *strong* solution of sodium or potassium hydroxid and a piece of yellow phosphorous, the size of a pea. Connect the tube leading to the bottom of the flask with a gas cock and drive out the air. To the other tube connect an 18-inch length of rubber tubing, in the end of which is inserted a glass delivery tube. Have the end of this tube bent up slightly and place it in a basin of water.

Now heat the contents of the flask and as the solution begins to boil a gas will be given off which spontaneously ignites on reaching the air.

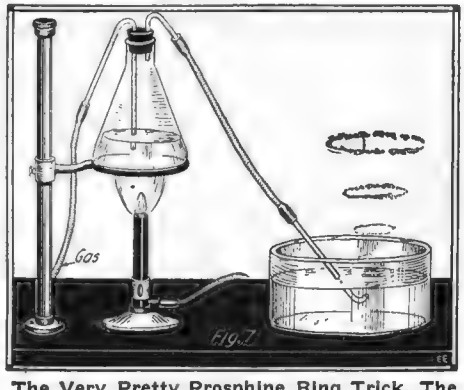


Your Own Gas Generator; Making "Water Gas." You Can Bottle It and Use It to Your Heart's Content.

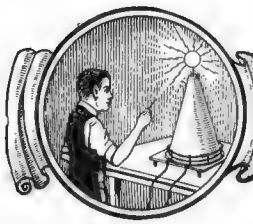
AN ACETYLENE LAMP.

Obtain a large mouthed bottle of one or two quarts capacity, a large lamp chimney, small disc of coarse wire gauze, one-holed rubber stopper, 6-inch length of glass tubing, rubber connection, acetylene gas tip and 18 inches of heavy aluminum wire.

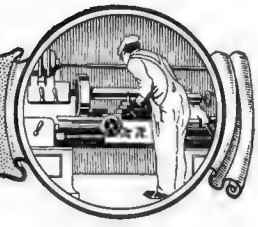
(*Continued on page* 1328)



The Very Pretty Prosphine Ring Trick. The Above Diagram Demonstrates a Stunt Which No Experimenter Should Refrain From Conducting.



THE CONSTRUCTOR



Home-made 110-Volt, 60-Cycle Induction Motor

By H. H. PARKER

MANY uses could be found for a small single-phase motor which would connect up to an ordinary 110-volt lamp socket, and while such motors are not high priced many Amateur Mechanics wish to build them themselves, but are deterred by the difficulty of making or obtaining field and rotor punchings, for, unlike the direct current variety, both the stator, or field magnet, and rotor cores must be built up of iron sheets or laminations.

No originality is claimed in the main design of the small motor to be described, but an attempt has been made to lay out a strong and substantial construction not too difficult to be built at home on a small screw-cutting lathe. The power of this little motor would depend to some extent upon the materials used and the workmanship and care in making the windings, but it should be serviceable for driving a fan, buffing wheel, rotary spark gap, or various types of light machinery. Having but one set of windings upon *rotor* and *stator*, it is not self-starting and will not start under a full load, this being characteristic of all such types of alternating current machinery. But by using a tight and loose pulley or a similar contrivance and giving the belt a sharp pull after throwing the switch, the motor will pick up speed without difficulty. Another crude but effective starting device is shown in the assembly drawing (Fig. 2); this consists of a spool shown on the left-hand end of the shaft around which a heavy cord is wound and the motor given a starting whirl by a quick pull of this cord.

In regard to the laminations: field and rotor are built up of sheets of "stove pipe" iron of about 22 gage, tho if regular transformer iron or silicon steel was obtainable a more efficient, as well as more expensive, machine could be produced. Even tho these sheets could be given a form simple enough to be cut out by hand, separately, with tinner's snips, this would be a formidable undertaking, and the method decided upon here is to cut out square sheets, pile them up, clamp together, drill out along the required outlines by means of a jig plate, then separate, break out the portions not needed and finish by filing and in the lathe. Even this means considerable work, when compared with the construction of a direct current machine, but to partly compensate for this the A.C. motor has no commutator, slip rings nor brush holders, the rotor windings being short-circuited. As seen in Figs. 1 and 2, the motor has four poles, with four stator coils, while the rotor has four wide slots and also four poles, with no electrical connection between stator and rotor. At a frequency of 60 cycles the speed will be a little under 1,800 r.p.m.

Fig. 3 shows the shape of the stator laminations and Fig. 4 of the rotor. By referring to Fig. 1 it will be seen that with the rotor in the position shown the spaces, or slots, in the rotor, lie opposite the stator pole faces, while the rotor faces lie next to the stator slots. By using care and with an accurate drill press or lathe drill pad, it might be possible to cut both a rotor and stator lamination from one sheet of iron, by making narrow separations at the corners where the rotor faces meet the corners of the stator poles. Otherwise separate square sheets must be used for stator and rotor laminations, requiring, of course, considerable more material. A saving could be effected by making each stator sheet in two parts, as per the dotted lines in Fig. 3, and "breaking joints" when assembling the pile, but this would introduce a little more reluctance into the magnetic circuit. Figs. 6 and 7 illustrate the method of making the drilling jigs out of a scrap plate of half or three-eighths inch cast iron or steel. Care should be taken in laying out these jigs that enough material will be left around the edges of the sheets, after drilling, to allow of a smooth finish. To use the jigs, the square sheets are piled up to make a depth of two inches, for both stator and rotor, when comprest; this would take about 68 sheets of 22-gage iron. After clamping or bolting, by the corners, to a hardwood board, the center hole is drilled and two lines scribed exactly at right angles thru the center; then the four 11/32-inch holes in the stator and 5/32-inch holes in the rotor are drilled, rotating the jig so as to use the same hole thru it each time and taking care that the holes were exactly ninety degrees apart. Then a pin is driven thru the half-inch hole of the jig and one of these holds the jig furthermore clampt to the pile, and one-quarter of the holes drilled; the jig is then shifted thru a right angle and the process repeated, and so on until all the holes are thru. With an accurate drill press the whole pile could be drilled thru at once, but in other cases it might be best to drill half of the plates, or a pile one inch high, at a time. The plates are now separated, the pieces broken out, reassembled and the edges finisht to size with a file. Previously to separating a shallow hacksaw cut should be made across the pile at some point, to insure getting them back in the same position, and before reassembling the outside corners are cut off to make less work for the lathe.

The stator plates are then assembled and bolted to the lathe face-plate, with a hardwood packing piece in between, centered up and bored out and the outside turned down to the given diameter. They must then be taken apart again and all burrs cleaned off the edges to prevent making electric contact between the laminations; before the final assembly each plate is given a thin coat of shellac on one side and allowed to dry. 5/16" bolts are used and each is wrapt in shellacked paper so that when dry it may be just driven into the 11/32" hole without tearing the wrapping. This bolt and rivet insulation is necessary for the insulation of the laminations. Similarly, ⅜" rivets are insulated and put thru the 5/32" holes. The plates should be clampt tightly together but not so tight as to spring them open where there are no bolts or rivets. The rotor core is similarly constructed, but the laminations are held on the shaft by two pairs of locknuts as well as ⅛" bolts, insulated with paper and fiber nuts, which also act as posts to hold the windings in place.

All the machine work must be completed before starting the winding. In regard to the bearings (Fig. 8-A), these are cast in brass or bronze; heavy bar brass with bearing bushings soldered or brazed in might also be used. The bearing yokes are separated from the stator core by cast iron, steel or brass posts, which also act as nuts to clamp the laminations together. There are several possible ways to drill out the bearings. One would be to put an 11/32" drill thru the bolt holes in the core, spot the bearing yokes and then drill and ream them 5/16". Then put in the 5/16" bolts (Fig. 7-A), insulated with shellacked paper and screw home the posts. Drill and ream to ⅜" a 2" length of steel shafting, drive it thru a hole in a 2" hardwood block, place between centers in the lathe and turn the block to a diameter that would just allow it to be pusht into the bore of the stator (3/16"). Then put in the short bearing studs (Fig. 8) and bolt one of the bearing yokes in place. Using the steel busht block as a jig, drill and ream the bearing yoke.

Two angle plates (Fig. 9) are cast in iron or brass for the motor base; these can be mounted on an angle plate on the face-plate and faced to take the stator core; one 5/16" bolt, also wrapt in paper, holds both in place.

The rotor laminations, as previously mentioned, are held to the shaft by two sets of locknuts, one set of which have 1" flanges. Or two 1" washers and four S. A. E. ½" nuts could be used. In any event, after screwing up these nuts and their lock nuts to clamp the laminations tightly, they are turned down to finish dimensions and the shaft also turned to finish size. If done previously to this, clamping the laminations might spring the shaft. Two grooves are turned, with sharp edges, to prevent oil working up into the rotor windings. A light cut is also taken to true up the surface of the rotor. Then the insulated ⅛" bolts are run thru and clampt by the fiber posts. Figs. 10, 11.)

THE WINDINGS.

Now for the windings. Procure a roll of "armature" tape, wrap some around the stator cores, tie it and cover with shellac. The construction of the stator precludes the use of *form wound* coils; so enough wire for one coil is wound on a spool small enough to pass thru the core, and the coil is wound by hand. A couple of split flanges of very thin fiber could be slipt on each end of the core and glued together, the splits opposite, to act as heads for the coil. No. 22 D.C.C. copper wire is used for the stator;

(*Continued on page* 1314)

Home-made A. C. Motor

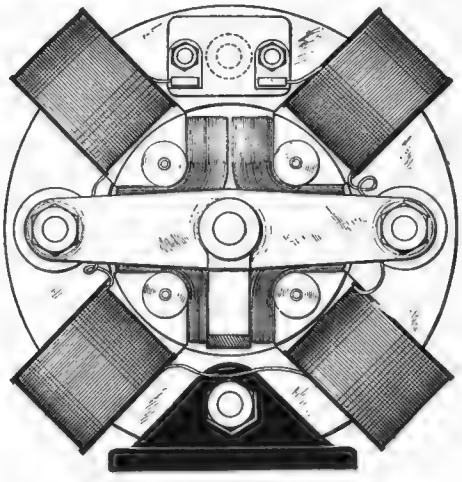


Fig. 1

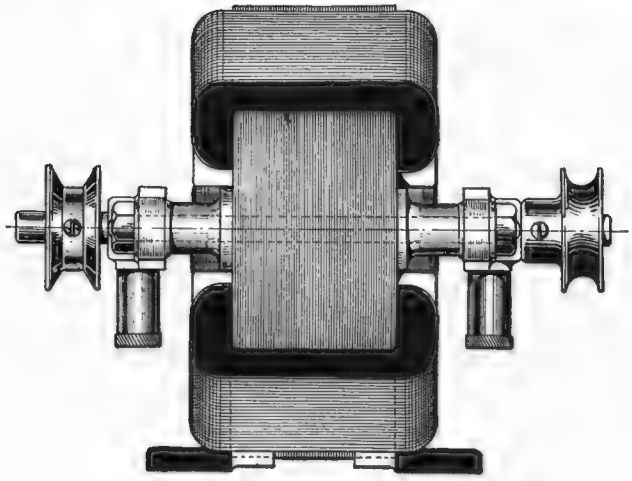


Fig. 2

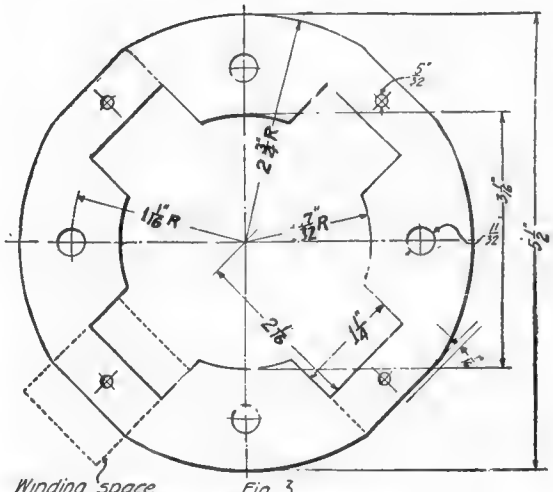


Fig. 3
#22 sheet iron 68 req'd

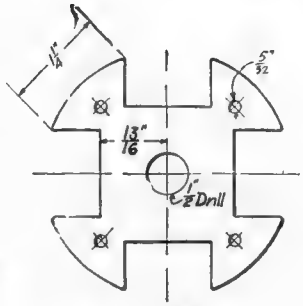


Fig. 4
#22 sheet iron 68 req'd

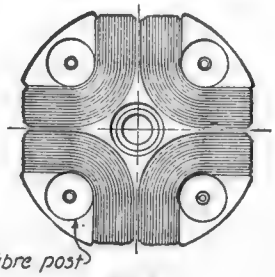


Fig. 5

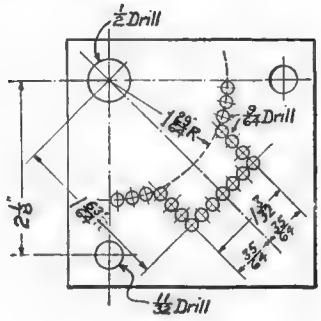


Fig. 6

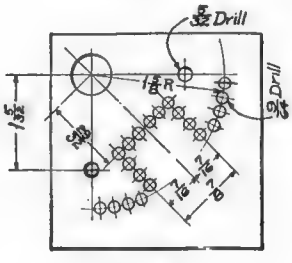


Fig. 7

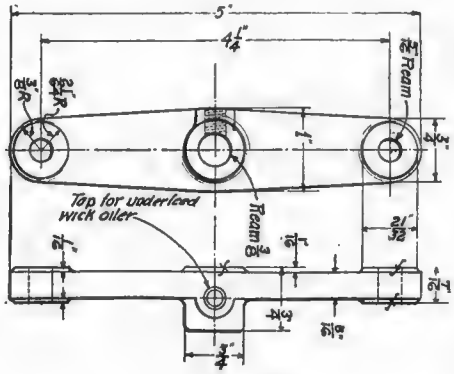
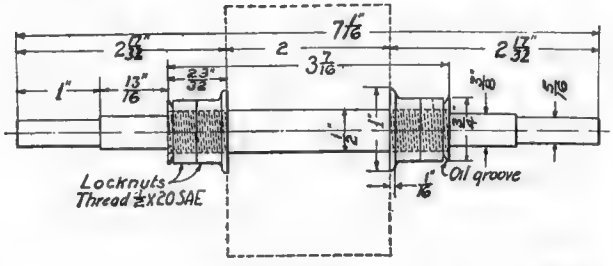


Fig. 8-A
2 req'd.

Fig. 11
8 req'd.
red fibre

Fig. 8
C.R. steel 4 req'd.



Motor shaft
C.R. steel 1 req'd.

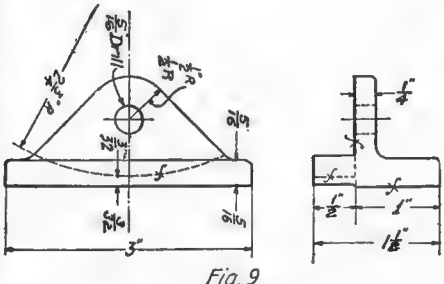


Fig. 9
2 req'd

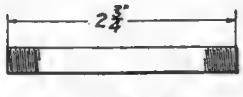


Fig. 7-A
C.R. steel 2 req'd

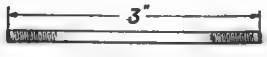


Fig. 10
C.R. steel 4 req'd

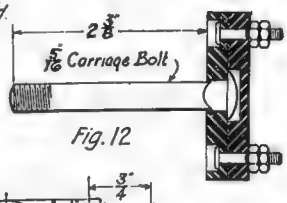


Fig. 12

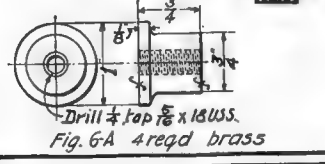


Fig. 6-A 4 req'd brass

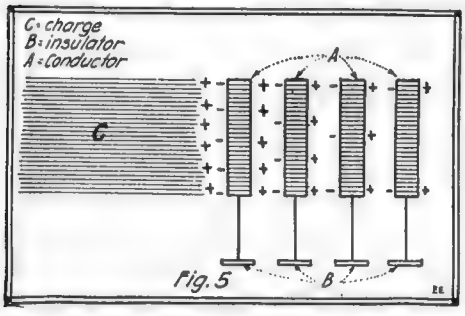
(Full Description Covering the Construction of This Alternating Current Motor on Opposite Page.)

The "Finer Workings" Of Static Electricity

By FREDERICK VON LICHTENOW

SECON' PAPER.

WHEN I had finished writing the (now) first part of "The Finer Workings" of Static Electricity, I felt that a limited treatise on the most vital phases of this particular form of electricity may not only help the beginner or uninitiated to gain a clearer



STATIC ELECTRICITY. Diagram Showing How a Series of Insulated Conductors May Be Charged by Super-Induction, the Individual Conductors Being Separated by Air Gaps as Shown. The Distribution of the Positive and Negative Static Charges Is Shown by the + and — Marks.

conception of what is demonstrated by the preceding experiments, but also considered it worthy the effort to lay down in an easily understandable manner the principal actions of this natural, electrical element, as I found them by experimentation.

Static Electricity has been my special Research-object, off and on during the past twenty odd years; and altho I had, during that time, observed many of its phenomena —both dim and pronounced in character— I venture to say, that numerous surprises are still waiting for those, who care to invade this wonderful region. The "Trail" has been carefully "Blazed" all the way to it long ago, has been kept open by ardent followers and added to, but a great portion of what lies on either side of it is well beyond; is as yet more or less engulfed by a tangle of doubts!

CHARGE AND CHARGING.

The various means by which a static charge is effected are found in any book on the subject and, consequently, need not be gone into any further here. The peculiar and unique action of this charge, in whichever way produced, however, embodies highly interesting phenomena, unclear if not wholly unknown to the beginner:

A static charge travels in any direction thru space; its natural trend being, of course, down and up, that is from the clouds to the earth or vice versa, forming its path by seeking whatever conducting body comes handy.

In order to retain such a charge for any length of time, *a supporting insulator is absolutely imperative.* Lightning, as it strikes a human being, an animal, a tree or a house does the damage during the instant while the charge is delivered, *but loses its force a moment after it reaches the earth* (a mammoth conductor). A probable exception from this is "ball lightning" and *only in so far,* that it has the peculiar trait of hovering over or moving along near the earth's surface for a fraction of time before its sphere of electric "fire" explodes. (All in all, a very rare occurrence!)

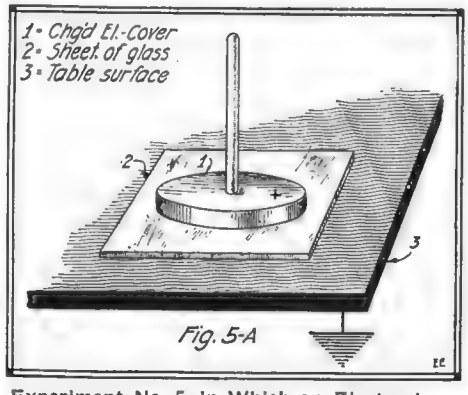
Any one of these electro-static charges is of a *Unipolar* character.

There are three ways of charging: *direct charging* (by contact); *indirect charging* (by induction, which is charging at a distance.) See Expts. No. 1-3-4, Part 1; and *circumstantial charging* (by superinduction), which embodies contact charging with an insulating body interposed between charge-source and conductor. See Expt. No. 2, Part 1.

But considering the peculiar nature of Static electricity there are *ever so many exceptions* from such fundamental, general rules, which (the exceptions) are some of the things that exemplify its "Finer Workings." And so it happens that contact charging at times becomes inductive charging (electrified insulator as charge-source!) and the same in reverse.

Likewise, charging by *superinduction* does *not always* include the *contact-element;* and a series of insulated conductors may be charged in this manner by having them separated by air-gaps. (See Fig. 5.)

As I have hinted at before: a conductor can only be charged, that is without losing its charge right away, as long as it is *supported by an insulator* of some kind: the



Experiment No. 5, In Which an Electrophorous Cover Is Statically Charged In the Usual Way and After Removing It From the Hard Rubber Sheet, It Is Placed on a Plate of Glass. The Charge Does Not Dissipate Instantly as Might Be Supposed, But Leaks Off Gradually.

air, silk thread, insulating stand, etc. (It so becomes a charge-source!)

It can be directly charged in this manner and will retain its charge for a certain, short time and also indirectly (Inductively) charged under the same conditions.

In the latter case, however, it will *not retain its charge any longer than it is kept under the influence of the waves emanating from the charge-source or removed from contact with the same,* which of necessity, has here to be an insulator. (Charged ebonite plate and electrophorus cover, for instance, if the latter is removed from the former without first grounding the repelled electrons!)

The only exception from this is furnished by "In-between-objects," like pith balls, which are neither good conductors nor good insulators.

Insulators cannot be charged directly by the application of a charged conductor, but may be "electrified" by the *friction method,* a thing impossible to accomplish with a conductor, *unless well insulated* (which applies also to the part with which it is in friction.)

They may so become charged on one end while the other one stays neutral, or charged evenly all over, as the case might be; and they will retain their charge for quite a little while.

However, they can be inductively charged (as well as by superinduction. Note: Glass plate in experiment No. 2, Part 1) but *only as long as they are in contact with the charge-source,* which here may be either an insulator or otherwise insulated charge-source.

True, inductive charging (distance charging) of insulating bodies, such as a sheet of glass, is also not so remote a possibility, as I found out, when such insulators are coated with a film of moisture (atmospherical dampness), which serves as a conductor. This is only one instance of the many circumstances which enter unbidden into static experiments and which, not seldom, overthrow time tested theories.

Proof, that an electro-static charge does not penetrate thru an insulator (sheet of glass, etc.) of a thickness, corresponding naturally with the value of the potential of such charge, is contained in the following experiment:

EXPERIMENT NO. 5.

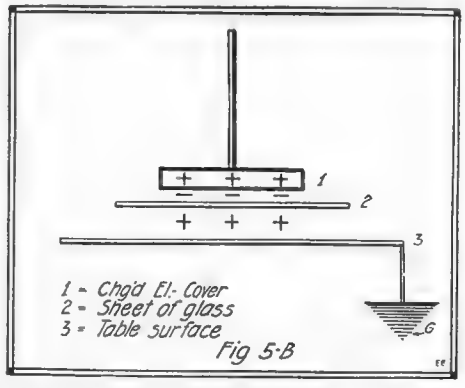
An electrophorus cover (tin box employed in the previous experiments) is charged in the usual way and, after removing it from the hard rubber sheet, placed on a plate of glass or other (neutral) insulating sheet. (Fig. 5-A.)

Altho this glass plate is grounded on the table and so should offer quite an inducement for the electrons residing on the cover to find a way thru, they can not accomplish this, but are retained on the cover. They gradually diminish, however, in value, which is the consequence of natural "leakage"; and this not more so than had the cover been suspended in space by a silk thread. In fact, its capability of holding a charge should now rather be increased, with the superinduced earth-force acting upon it, ("Bound" Charge!) Fig. 5-B.

SPARKS AND POLARITY.

It takes two opposite poles to produce a spark. A "unipolar" electro-static charge cannot do it.

When a lightning bolt cuts thru space, its blinding glare and tendency to branch out and to "Zigzag" are the consequences of its striking and reaching for oppositely charged waves of electricity in its path and



Continuing the Argument Set Forth at Fig. 5-A, the Electrophorus Can Hold the Charge More Efficiently, In View of the Superinduced Earth-Force Acting Upon It (Bound Charge).

is also the result of its tremendously high potential. For, these ether-waves need, of necessity, not primarily be charged, may be neutral even, but will become *inductively electrified*—and pretty high at that!—when this happens. There is nothing changed in the unipolar element contained in the bolt of lightning, except that it loses some of its force; on the contrary, this only substantiates the fact that a charge can only be of a "unipolar" character.

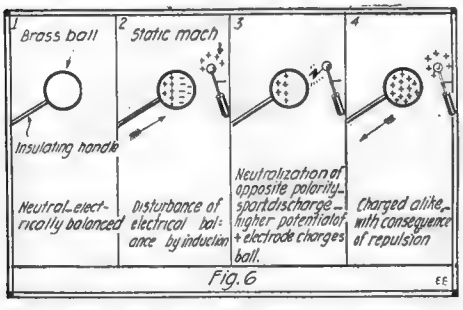
As such, when insulated and approached by another insulator it is as tame as a dove. Nothing happens. A somewhat different aspect is offered, when—to give an example—(serving as Expt. No. 6.) a metal object, in neutral condition and held by an insulating handle, is brought near one of the electrodes of a static machine in action. Sparks will jump over, naturally, and they will continue to do so as long as they find a complement of electrons of *opposite* sign upon that object. These have partly existed and are in addition induced there (on the object being approached) and taking atmospherical conditions into consideration—are nourished to it more or less from the air (a metal body is a first class conductor and acts like a sponge in respect of properties of attraction, *especially under pressure of induction!*) so that the sparking often continues for a long time. If everything was just right or as it should be, the sparking would cease after a few moments; for, with the opposite electricity consumed by the "neutralizing" spark, all further attraction on the part of the metal body stops. All that is left upon it is a charge, which it has acquired during the process, and which is of the same sign as that of its erstwhile repelled electrons (but of a higher potential) as well as that of the charge-source (see Fig. 6).

A pronounced effect is, quite naturally, gained when the unipolar charge is permitted to reach a grounded conductor, in which it finds all the opposite electrical properties that it is longing for. It then—and only—really manifests all the "Earmarks" of a charge and in proportion to its potential becomes dangerous to a lesser or higher degree. That is the basic principle of the spark discharge, the *rushing together* of *opposite* polarities;—that forms the spark!

The entirely opposite character of a positive (+) and negative (—) pole—the two signs of electricity—is in so far still further enhanced, that the positive element is an *excess* of charge while the negative is a *deficit.*

According to the manner of charging an object as well as according to the potential of the charge-source and its own polarity, so will the respective polarities, naturally vary in their arrangement upon such objects.

The experiments and illustrations furnished with Part 1 of this paper show this quite clearly, which eliminates a repetition here, while Fig. 6 demonstrates the polar-distribution as nearly so as when direct charging is resorted to (not touched upon in Part 1.) with the only difference, that by actually direct (contact) charging, induction and neutralization follow one another *so rapidly,* that the induced, oppositely polarized element exemplifies another case of "Spurlos Versenkt"!—No evidence of it nor even time enough for such!



It Takes Two Opposite Poles to Produce a Static Spark—a Unipolar Electro-Static Charge Cannot Do It.

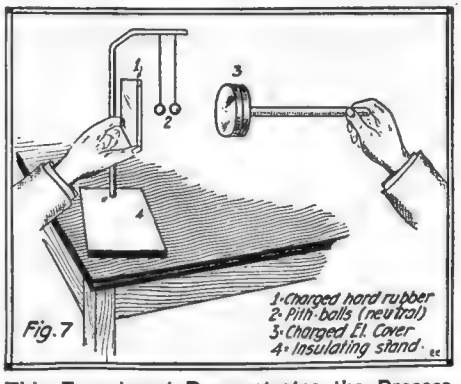
In any and whatever kind of charging of a neutral body, *induction* takes place first, followed by *attraction* and ended by *neutralization.*

NEUTRALIZATION.

Neutralization embraces everything in Static Electricity. It is there at the beginning and at the end; and the visible or otherwise perceivable action that lies between is nothing but the *evidence of its re-creation,* or the manifestation of the process in re-establishing the electrical balance.

Normally, everything on earth is static electrically balanced, that is positive and negative electrons are evenly distributed upon the things around us. Both polarities are conglomerated—so well mixed—that, as is self-evident, polarization cannot exist in such a case. The condition of such objects is then called "Zero," which means *neutral.*

As a natural consequence of the disturbance of this electrical balance under the effects of friction, heat, motion, etc., their potential becomes abnormally raised, which constitutes a charge or polarization. Some objects become positively polarized, others negatively, but only the *neutralizing action* furnishes *proof of the existence of a charge,* either directly or in a round-about way. For, it is well to remember that even like charged bodies, which ordinarily repel one another and plainly show this wherever possible, are such only *temporarily* and that they seek either a neutral or an oppositely electrified object by way of *compulsory attraction.* And attraction as such is *neutralization at a distance,* with the naturally "forerunning" induction. This shows, on the other hand, that they need not come in actual contact with a neutral or an oppositely charged body, but will become *neutralized thru the air in due time, if there is no way open for making contact.*



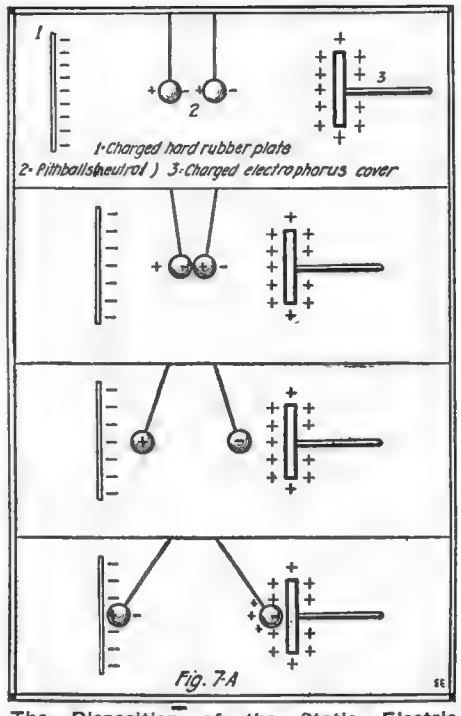
This Experiment Demonstrates the Process of Neutralization in as Near a Prolonged Manner as It Seems Possible to Accomplish With Such Simple Apparatus. The Static Neutralization Apparatus Required to Perform This Experiment, Including the Two Pith Balls, Are Easily Obtained and Cost Practically Nothing.

Neutralization is simply *the electrical law of the earth* and nothing can get around it.

While oppositely charged conductors neutralize their charges almost instantly on contact, or thru a spark at the proper distance, insulators do so unperceivably slow as well as only to a limited degree and, invariably, without the manifestation of a spark. This is partly due to the low potential to which only they can be raised, partly—and in the main—the result of their make-up, which *characterizes them as insulators.*

So it is possible, as I have already pointed out, that a hard rubber rod may become charged on one end and stay neutral on the other. But not only that; an electrified glass rod (+) may be rolled to and fro over a charged sheet of ebonite (—) and yet both will retain their respective polarities. No doubt, their charges lose some of their former strength, but unprovable little of it under this process. The insulating properties are so excellent, that by bringing a charged conductor and oppositely electrified insulator in contact there is *no noticeable evidence of neutralization*

All this becomes greatly changed, when atmospherical conditions (dampness) transform an otherwise good insulator suddenly into a fairly good conductor, which has also been hinted at in the foregoing. And under such circumstances neutralization works *overtime!*



The Disposition of the Static Electric Charges in the Pith Ball Experiment Illustrated at Fig. 7, Where the Electrified Electrophorus Cover and Electrified Hard Rubber Sheet Are Slowly and Simultaneously Projected Toward the Pith Balls From Either Side.

EXPERIMENT NO. 7.

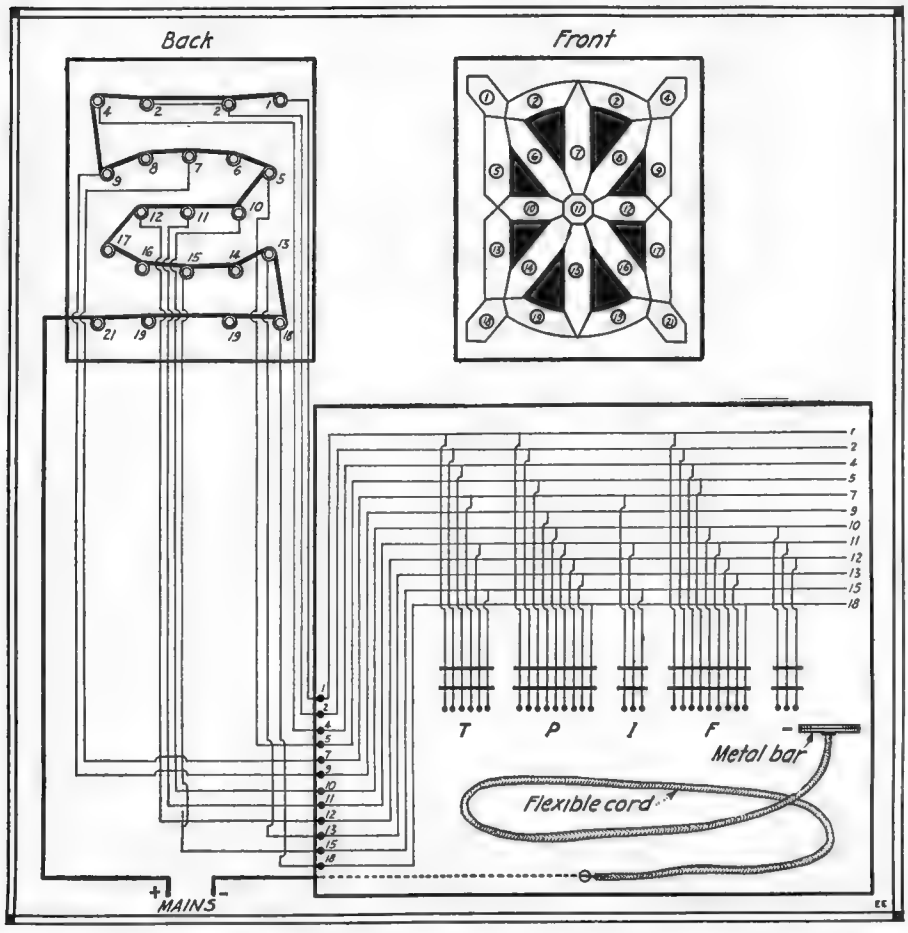
This experiment demonstrates the process of neutralization in as near a prolonged manner as it seems possible to accomplish with such simple apparatus. Fig. No. 7 refers to the instruments and their arrangement and shows the pith balls hanging very close together, *almost in contact,* as they should hang. This is important. Of further importance is that the charged El-cover and electrified hard rubber sheet are *slowly* and *simultaneously* approached from either side (each one facing only one side of each separate ball!) with the potentials of the two charge-sources given *individual* consideration. That means, the more strongly charged El-cover should at no stage of this experiment approach as near to its ball as the electrified ebonite plate be permitted to close in on its own.

Contrary to the expectation of the uninitiated or to the general law of attraction these light objects will not fly toward their respective charge-sources, but will join and cling together. When this happens their inductively repelled "inner" charges neutralize, and all action of the operator should stop here for the time being; for if he brought the charge-sources any closer he would simply accelerate the process and spoil the experiment.

In fact, the feeble element of attraction existing between the two balls overcomes the powerful attractive properties exerted upon them by the charge-sources only by reason of their—the balls—close proximity to one another and the greater distance that lies between them and the charge-sources.

(*Continued on page* 1324)

Electro-Monogram Sign for the Boys



Something of Interest to Every Young Electrician—an Electro-Monogram Sign Which Is Easily Constructed at Small Cost.

HERE, boys, is a signaling outfit that you may use at night, spelling out, one letter at a time, any message you desire to send to your "pal" across the street or over on the next avenue. No code is necessary. You merely place a metallic bar across groups of wires and the monogram, which contains electric lights, forms the desired letters.

You may construct the monogram any size you desire. A small one may be operated with batteries, or a large one may be connected with the 110-volt lighting circuit of your home.

A shallow box is used in the construction of the monogram. In case you make a small size, a cigar box of proper proportions is just right. It should be slightly longer than it is wide, but the proportions do not need to be exact.

The light portions of the monogram shown in the picture are troughs. Thin wood or metal may be used in making these troughs. They should be about as deep as the length of the lamps used in them, allowing a glass front to be placed on the monogram if desired. Each trough is furnished with a lamp, as indicated by the numbered circles. The troughs are painted white to form a reflector. Thus when lamp No. 8 is lighted, the whole trough indicated by No. 8 is lighted. When various combinations of these lamps are lighted, different letters may be formed. The entire alphabet and all of the numerals may be formed with this monogram.

The wiring diagram is shown on the back of the monogram. The heavy line is a continuous wire which is attached to one side of every lamp. This line goes to one side of the battery or power line.

Now one wire is run from the other side of each lamp to the switch-board terminals shown on the left of the board in the drawing. The lamps numbered 2 and those numbered 19 may be connected to one wire, as there is no letter that requires the use of one No. 2 lamp without the other. The same holds true in the No. 19 lamps. That means that we have nineteen wires to connect to the switch-board terminals. Only twelve wires are shown in the drawing for the sake of simplicity.

On the switch-board the nineteen wires are run across loosely until the letter groups such as T, P, I, F and the dash have been tapt. They may then be formed into a cable to give plenty of room on the board for the letter groups.

By tracing out the wires in the T group, it will be found that the lamps to which these wires are connected will form the letter T when lighted. The same is true of the P, I, F and dash groups. The wires forming the letter groups are stretched across bridges about a quarter of an inch high and fastened at the ends. The bridges should be made of wood or other non-conducting material. The portion of the wires between the bridges should be bared.

Now a wire is run from the source of current to the center of the bottom of the board and there a single-wire cord is attached. At the end of this cord a T-shaped metal bar is placed. The handle should be wrapt with tape or otherwise insulated if strong current is used. The bar must have contact with the wire cord. When the bar is placed across the bare wires in any letter group, the lamps to which those wires are connected will be lighted, illuminating the desired letter.

The letter groups may be arranged in rows in alphabetical order or after the manner of a typewriter keyboard. When the operator gets accustomed to the positions of the letter groups he will be able to spell out messages with great rapidity.

Contributed by ALTON D. SPENCER.

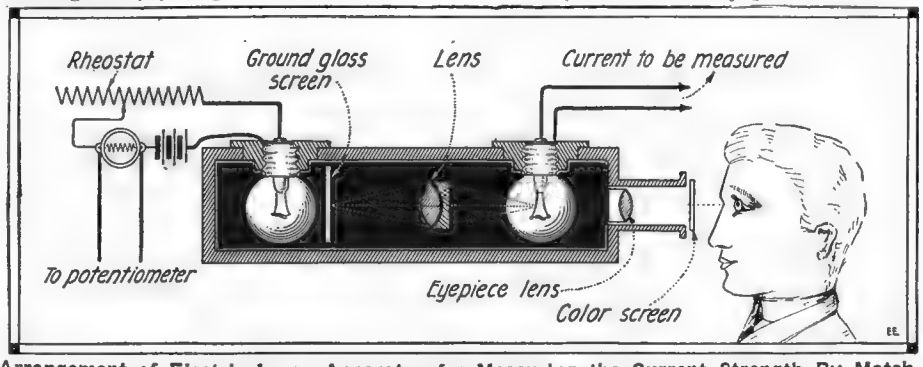
Measuring Electric Current With the Eye

By C. A. BRIGGS

A WASHINGTON scientist at the Bureau of Standards has devised an ingenious arrangement whereby it is possible to measure the amperes of electric current by means of a sort of photometer. In his scheme the brightness of a hot filament is matched against a bright background. This may have an application to alternating current work, and particularly to wireless work where it has been always necessary to get some means whereby the value of an alternating or high-frequency current can be reduced to its equivalent direct current.

The method can be understood by reference to the accompanying diagram. The electric bulb at the closed end illuminates a ground glass screen the image of which is thrown, by means of an achromatic lens, on the filament of the second bulb. The filament of the second bulb is viewed against the bright background thus formed by means of the eyepiece, which is provided with a color screen so that the observer is working always in light of one color. The first bulb is heated by an electric current controlled by a rheostat. The value of this current can be determined, as indicated in

(*Continued on page* 1324)



Arrangement of Electric Lamp Apparatus for Measuring the Current Strength By Matching the Brightness of a Hot Filament Against a Bright Background.

1—Great Care Must Be Taken In Removing the Plates from a Storage Battery, So As Not to Damage the Lead Paste Filling. 2—See to It That the Insulators Between the Lead Plates are Perfect and Not Cracked Or Broken. 3—The Terminal Connections May Be Soldered Or Fused By Current Obtained from Another Storage Battery, Using a Pointed Electrode As Shown.

Storage Battery Repairing

By HENRY KLAUS

SINCE automobiles have become so popular many profitable occupations and side lines are afforded for rebuilding and adjusting their various parts. This is especially true of storage battery repairing and recharging. Most garages in small towns are not in a position or have not time to take them apart and bother with them, so they send them away to some larger place to have it done. Any one with a little experience can do this and make a handsome profit besides. It is the object of this paper to explain briefly the main points to be observed in the application of this work.

The equipment needed comprises a syringe hydrometer, voltammeter, welder (electric home-made), saw, blow-torch, test clips lead covered, pincers, sulfuric acid, solder, distilled water (can be made in the still shown), generator or rectifier and lamps for charging.

While battery repairing could be done without a charging apparatus, it would be very inconvenient to carry them to a garage or service station to be charged every time after they were finished. Many experimenters are equipt with D.C., or, a rectifier can be purchased from any electrical house. It will pay well to install this because the money expended is soon made back on it.

When a battery is brought in the first thing to do is test the voltage. If the cells show from 1 to 2 V. each they probably need only charging. Next draw enough electrolyte from each cell separately into the hydrometer syringe to float the hydrometer, take reading, and put it back again in the same cell. The table below shows the relative strength of the battery at the various readings:

1250	80%	strength	of	battery
1225	60%	"	"	"
1200	40%	"	"	"
1175	20%	"	"	"
1150	exhausted.			

A fully charged battery should have a Sp. Gr. of 1.275, or 1275 on the hydrometer, but it sometimes occurs that one shows a density of 1300 or even 1325.

The charging rate will be found on the lead name plate tacked to the case. Here is an example:

Start 13½ Amp. Finish 4½ Amp.

In this case a current of 13½ amperes (about 14-100 Watt lights in the lamp bank explained later) is allowed to flow until the cells gas freely, then continue the charge for 6 hours at the finish rate (in this case 4½ amperes with about 5 lamps connected). Never hold a match near the vent holes while charging as the products of electrolysis explode. If one of the cells has become short-circuited or for some other reason is below the rest, it should be charged separately until it is up with the others and then connect them all in. Some times a cell lags behind because the electrolyte leaks out of a cracked jar, and every time water is added the Sp. Gr. becomes less. This is taken up later. If the Sp. Gr. does not reach 1275 or over after 6 hours of charging at the finish rate continue at this rate until there is no increase. If a battery has been neglected for a long period it may take several days to bring it up to capacity. Never add acid to raise the density until the battery is fully charged. If it must be added it should have a Sp. Gr. of 1210.

A battery set away for the winter or standing idle for any length of time should first be fully charged and afterwards at intervals of one or two months to keep the Sp. Gr. up as long as it is not in use. A repair station should make a specialty of storing batteries for auto owners. If the batteries are neglected and allowed to freeze the active material of the plates becomes spongy and will fall off. The table gives the freezing points of various densities.

1150	Freezes	20°	above	Zero Fahr.
1180	"	0°		
1215	"	20°	below	"
1250	"	60°	"	"

On a 110 Volt circuit a 100 Watt lamp draws nearly 1 Ampere and a 50 or 60 W. ½ Amp. When these size lamps are used for the charging resistance (110 V.) the current flow is easily calculated. The connections for this outfit are shown in the diagram. Don't forget to connect the positive side of the current supply to the positive terminal of the battery. Quite a number of batteries can be connected in series and charged at the same time. If you have test clips put them on the ends of the charging terminals, painting the positive red; also provide a few wires about a foot long with a test clip on each end. With these a connection is easily and instantly made.

Very commonly a battery comes in that has one or more cells which will not raise even after a day or two of continuous charging. This condition is usually caused by warped plates which have worn thru the insulators and touch each other. Such a cell, obviously, cannot be charged as the current goes thru the point of contact. The only remedy is to take out the plates and insulate the places where they come together. A whole new insulator can be put in, or, a strip an inch wide can be put in from top to bottom where the pressure comes. These insulators may be obtained from any house selling storage batteries. (Diagram shows putting in separators.)

As they increase in age storage cells deteriorate. In a storage battery the active material falls from the grids. This is hastened where they are used on an automobile, because of the jolts they get. The more material they lose the less charge they will hold. It is the positive element that almost always falls out first and a new set of these plates will often make a good

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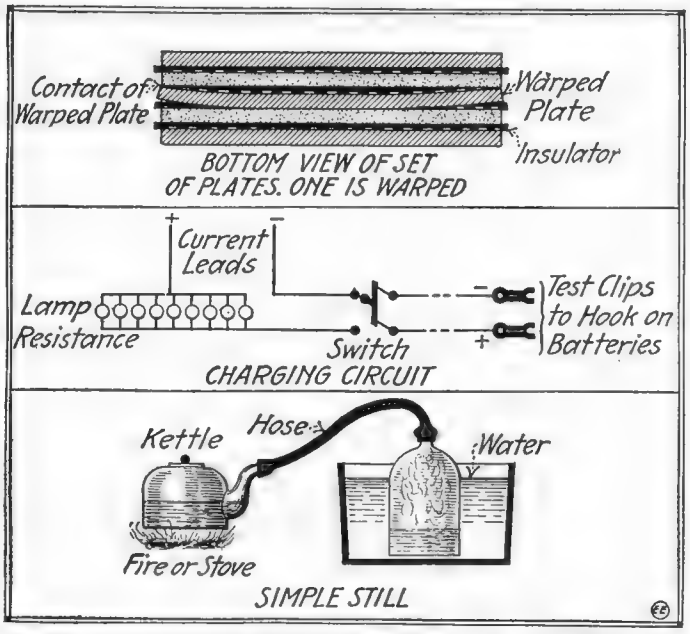


Useful Hints On Storage Battery Repairing. Top—How Plates Become Short-circuited By Sulfating, Over-discharge Or Over-recharge. Center—Charging Circuit with Lamp Bank. The Lamps are of the Voltage Rating of the Line Potential. Positive Line Goes to Positive Terminal of Storage Battery. Bottom—Simple Still Made from Kettle and Large Bottle for Distilling Water for Storage Cells. Never Use Spigot Water—It Invariably Contains Sufficient Mineral Traces to Sulfate or Disintegrate Your Battery Plates.

The Electrical Machinist

By H. WINFIELD SECOR

No. 6—ERECTING MOTORS AND SHAFTING

THE erection of dynamos and motors is always a matter requiring extreme care, particularly when it comes to properly and exactly alining the pulleys on the motor and on the shaft which it is to drive. The leveling of the

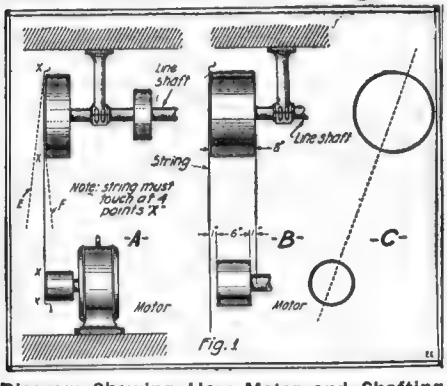


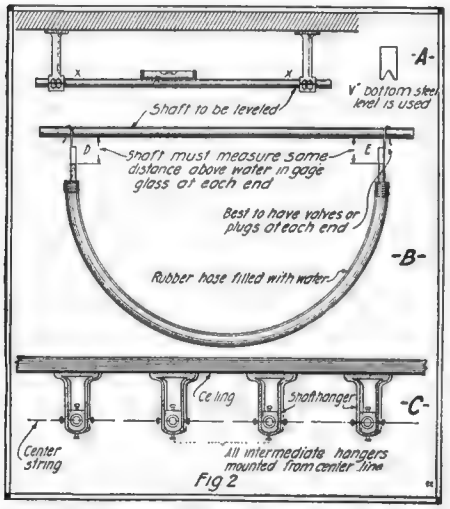
Diagram Showing How Motor and Shafting Pulleys Are Lined Up for Belt Drive by Means of a String or Chalk Line. If One Pulley Is Narrower Than the Other, Then It Is Centered as Shown at "B."

base of the machinery, as well as the leveling of the shaft are also very important matters which we shall here give our consideration.

Referring to Fig. 1, A, B and C represent different phases of the art of alining two pulleys, such as those on a motor and on a line shaft. At Fig. 1-A, the fundamental principle followed in lining up two pulleys of equal face width is illustrated. A strong cord or chalk line is held across the two faces of the pulleys so that the string shall touch at the four points marked "X." Usually two men do this, but if you have to do this alone, as will happen occasionally, then the string may be tightened around the pulley or otherwise secured at its highest point, when you can easily pull the string taut and bring it gradually into line with the lower base of the top pulley, and then move the motor to be mounted into position, so that its pulley face will be in perfect alinment with the cord.

Care must be taken to see that the cord is not allowed to assume an angular position such as shown, in a greatly exaggerated manner, by the dotted line E and F.

In some cases the two pulleys, that is the driver and the driven, are not of the same face width. In this case the string is applied as shown at B, in the usual manner, and by means of a rule the difference between the two pulley widths is divided up proportionately. For instance, if the larger pulley has an 8-inch face and the small pulley a 6-inch face, then if the two are to be alined, as is most always the case, then one inch space should be allowed on each side of the small pulley face when it is checked by a cord held on either side of the large pulley, as becomes clear upon examining the diagram.


-A-
V bottom steel level is used
Shaft to be leveled
Shaft must measure same distance above water in gage glass at each end
Best to have valves or plugs at each end
-B-
Rubber hose filled with water
Ceiling
Shafthanger
-C-
Center string
All intermediate hangers mounted from center line
Fig 2

Several Schemes Followed In Alining Shafting. The Stunt Employing the Rubber Hose Filled With Water and Fitted With a Gage Glass on Either End Proves Very Successful and Useful.

If the method of lining up pulleys with the cord is not quite clear, a glance at Fig. 1-C will make it so. Here it is seen how a cord is past, as nearly as possible, across the two diameters of the respective pulleys. Where the shaft projects thru a pulley, then the cord is simply pulled taut a little to one side of it, which gives exactly as good results as if there were no shaft projection, and the string past exactly over the diameters. The length of the belt, which is to connect the pulleys is usually measured by means of a strong, non-stretchable cord, past over the two pulleys or else by means of a tape measure.

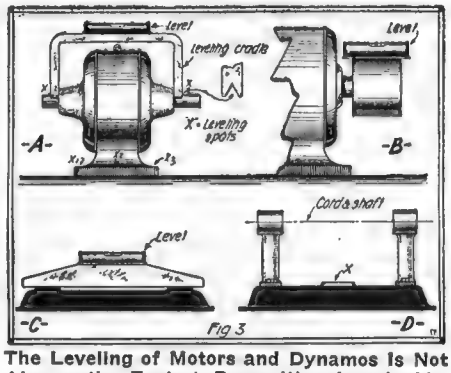
If the belt is to be a very exact fit, and of the endless variety, then the tape measure should be a steel one, so as to give a very exact reading. Most all motors, however, are fitted with belt-tightening screws on their base, so that quite a little variation is allowed for tightening up the belt, once it is put into place.

LEVELING SHAFTING.

The leveling of shafting, whether large or small, is an important affair, if the best efficiency and quietest running results are to be obtained. Figs. 2, A, B and C show some useful wrinkles in leveling shafts. The usual method for ordinary work is to employ a first-class steel level—preferably one having a V-shaped bottom—and the shafting should be turned into several different positions, so as to get a mean average on the level readings, and also the level should be placed on several points along the shaft while making the measurements, such as those indicated by X, X, X.

A unique suggestion to help in simplifying the leveling of long shafts, or, for that matter, short ones, is shown at Fig. 2-B. Two boiler gage glasses or other suitable glass tubes are hooked up with a length of rubber garden hose or rubber tubing; this is then filled with water, the water not quite reaching the tops of the gage glasses. The free ends of the gage glasses are fitted with hooks, which may pass over the shaft and hold it in position in the manner shown. This method is quite exact indeed, as it is well known that water or any other liquid will always seek its own level. In this case we at once perceive that the water level in the two gage glasses will be the *true level*, and if we then measure from these points indicated on the gage glasses to the surface of the shafting and keep changing the position of the shafting until these two distances, D and E, are equal, then we know that the shaft is perfectly level.

Where several shaft hangers have to be put in place before the shafting is available, the hangers are readily lined up and secured to the ceiling or side wall, whichever the case may be, by means of a center cord or string, as shown at Fig. 2-C. If more than two hangers are to be mounted by this method, then the two extreme end ones should be alined and put into place first. Intermediate hangers can then be readily lined up by means of the center string, which should be placed exactly thru the centers of the bearings in the end hangers, as becomes evident. Of course the string must be carefully checked up with a good spirit level, so that it is in a perfectly level plane. The shaft hangers are usually held on ceiling beams by means of lag bolts.



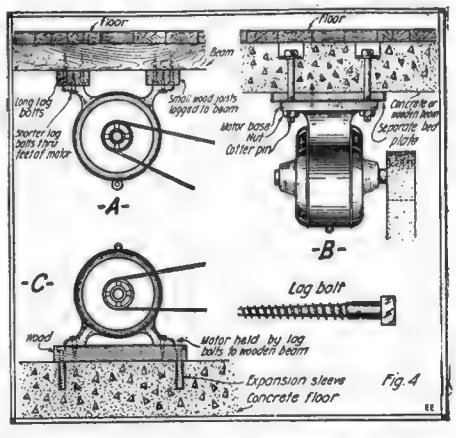
The Leveling of Motors and Dynamos Is Not Always the Easiest Proposition Imaginable. Several Ways of Leveling Up Electrical Machinery Are Here Shown.

LEVELING DYNAMOS AND MOTORS.

The leveling of dynamos and motor frames is not always the easiest task imaginable. This is particularly true in the case of small motors and dynamos having round or special housings, as shown at Fig. 3-A. An idea which can sometimes be brought into play, for such machines, is to have a leveling cradle of the form shown, and which may be adjustable for different sizes of machinery, which can be placed so as to rest on the shaft on both ends of the motor. The two lower feet of the leveling cradle should have V-shaped slots in them. The level is then placed on top of the cradle, as shown. In other cases there is often a sufficient amount of machined surface on the base of the motor so that it can be leveled in the necessary two directions, *i.e.*, at right angles to one another at the points marked X1, X2 and X3, or on both sides, and front and back of the base.

In some instances it is possible and permissible on a small motor or dynamo to level it close enough by placing the level proper on the face of the pulley, as shown

(*Continued on page* 1323)



Small and Medium Size Dynamos and Motors Are Here Illustrated, Mounted on Both Ceiling and Floor. Motors, Even Small Ones, Should Not Be Held to the Ceiling Beams by Lag Bolts Alone for a First Class Job, as Belting Strains Are Liable to Pull It From Its Moorings.

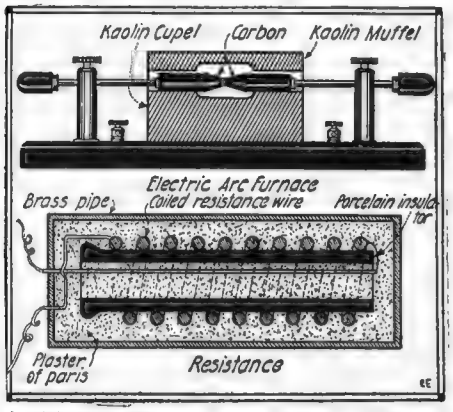
HOW-TO-MAKE-IT

This department will award the following monthly prizes: First Prize, $3.00; Second Prize, $2.00; Third Prize, $1.00.
The purpose of this department is to stimulate experimenters towards accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best idea submitted a prize of $3.00 is awarded; for the second best idea a $2.00 prize, and for the third best prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings Use only one side of sheet. Make sketches on separate sheets.

FIRST PRIZE, $3.00

A "TESTED" ELECTRIC FURNACE.

I am a reader of your magazine and have been interested in some of the experiments publisht in it, and am therefore taking the liberty of sending you the diagrams of an electric arc furnace which I



An Electric Furnace That Works! A Rheostat Is Used In Series With It.

have used in my laboratory for some time with good success.

I believe the diagram to be self explanatory of the method of construction, and can be made from odds and ends to be found in any shop. I have used the above furnace to fuse brass, copper, silver, gold and platinum very satisfactorily as a high degree of heat can be obtained.

I also give a diagram of the resistance used in connection with the furnace. I used about thirty feet of No. 24 iron wire wound into a 3/16-inch coil which I then wound around a 4-inch porcelain tube. This was then suspended in a piece of brass pipe 6 inches long and poured full of plaster of Paris. It must be noted that before this can be used it must be placed over a very slow fire and thoroly dried out; else it would either burn out the coil or explode, due to the moisture being driven off too rapidly. I used this outfit on the regular 110-volt circuit.

Contributed by DR. A. T. FRIEDLINE.

UNIQUE RUBBER FEET FOR APPARATUS.

I had my wireless apparatus on a high polished table and as I did not wish to mar the table by fastening the apparatus to it, besides being bothered by having the instruments slide out of place and scratching the top, I cut up some rubber bands (about ¼" x 1") and glued them around the edge of the base, 8" or 10" apart.

Contributed by HERBERT M. MAUS.

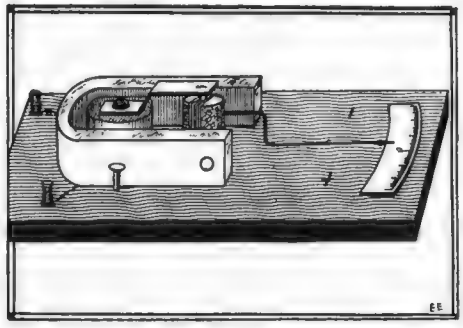
Rubber Feet Improve the Insulation of Any Electrical Instrument.

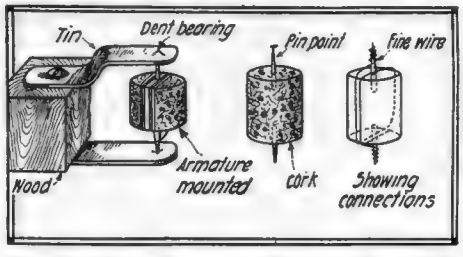
SECOND PRIZE, $2.00

MAKING A PERMANENT MAGNET METER.

I have experimented quite a bit on making various kinds of meters and have found great satisfaction in the ammeter here described. Procure a horseshoe type permanent steel magnet, about the size of a telephone magnet; a cork, some fine magnet wire, tin, cardboard and pins, etc. Cut the heads off the pins and insert one in each end of the cork, but be careful that they do not touch—and wind the wire around the cork, as in illustration, and connect each end of the fine magnet wire to the two pins so the pins act as bearings and the cork as an armature. Mount the armature between two pieces of brass strip to act as bearings and place the armature between the poles of the horseshoe magnet. Next bend a piece of copper or aluminum wire and insert one end into the cork. Mount the meter on a planed wood base and fix a cardboard dial under the wire. Calibrate it by means of a standard ammeter and batteries.

Contributed by LEE HOLMES.



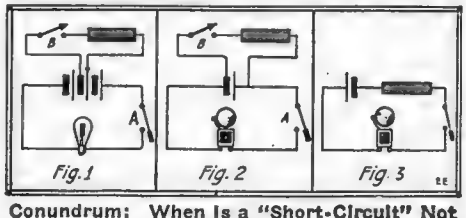


The Simplest Permanent Magnet—Moving Coil Meter. Nifty for Experimental Work.

A SHORT-CIRCUIT EXPERIMENT.

Practically everybody knows that if a battery connected to a bulb is short-circuited, the bulb will go out. But look at Fig. 1. The short-circuiting element is an ordinary battery carbon. Close switch A and the bulbs light brightly. Close switch B, and no change in bulb. Why shouldn't it dim? Oh, you think, you only "shorted" one battery. But look at Fig. 2. Here after A is closed and then B, the bell still continues to ring, despite the fact that *all* the current is short-circuited. Oh, you say, current does not pass thru carbon. But connect as in Fig. 3 and the bell will ring, indicating that it will. The owner of a Wheatstone bridge will easily ascertain the reason, however. It is a well-known fact that electricity will pass thru the conductor of least resistance.

Contributed by PHILIP A. WALL.

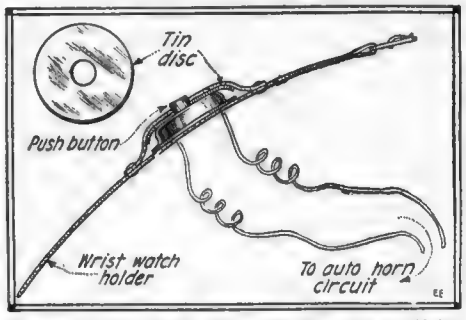


Conundrum: When Is a "Short-Circuit" Not a Short-Circuit?

THIRD PRIZE, $1.00

A CONVENIENT HORN DEVICE FOR AUTOMOBILES.

Purchase a wrist-watch case for about 50 cents and cut out a piece of tin large enough to admit a push-button, but leave the outside rim large enough to fit the watch case snugly. Procure a flexible lamp cord of sufficient length to permit the



Mount Your Auto Horn Button on a Wrist Watch Band and See How Convenient It Proves.

driver to hold one end with his arm outside the car, as when turning a corner. Now connect the wires to the button and to the electric horn circuit. Our circuit being complete, let us pass on to the uses of the push-button. You may strap the button to your index and second finger, so that the button may be in place for the fingers to be prest against the wheel without removing the hand. Now again, to blow the horn while turning a corner. Simply extend the hand and press the button with the thumb, and continue to steer the car with the other. By this arrangement you may blow the horn, signal to turn the corner by extending the arm, and guide the car—all at the same time. If the driver should not wish to use the button all the time, he may wind the wire around the steering rod and strap the button anywhere on the steering wheel. But pessimists may argue—"They will be easily stolen." I maintain that you can place a separable connector costing 15 cents in the circuit, so that the apparatus may be disconnected and placed under the seat or elsewhere. I find this a decided improvement over the present method, and think it will be worth a trial by all motorists.

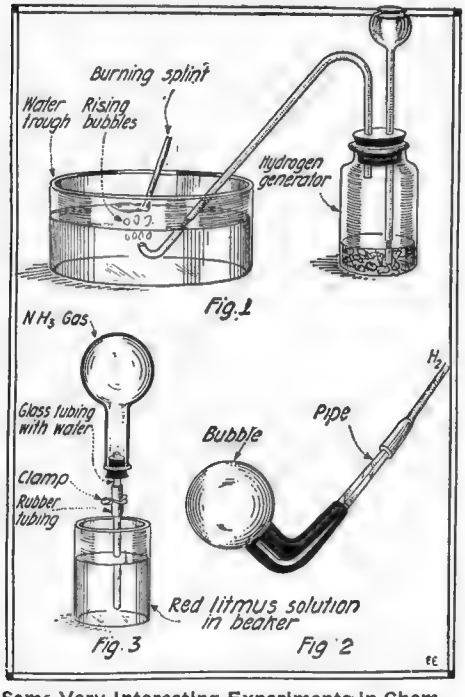
Contributed by LYLE CASHION.

Wrinkles, Recipes Formulas

EDITED BY S. GERNSBACK

INTERESTING CHEMICAL EXPERIMENTS.

1. Heat a little sulfur with concentrated nitric acid until it has disappeared. Observe the red fumes. Insert a burning match into them and note that they support combustion. When the reaction is over, allow the tube and its contents to cool, then add barium chlorid solution and a white precipitate will be formed. This shows the presence of sulfuric acid. The sulfur has been oxidized by the nitric acid to sulfuric acid.



Some Very Interesting Experiments in Chemistry are Here Illustrated and Described.

2. Burn a little sulfur in a bottle of oxygen and note the phenomenon. Do the same with phosforous. This time if the room is dark, the reaction will be more brilliant. Burn some charcoal also in oxygen and note the scintillation. Slip a small piece of cotton into melted sulfur, then attach it to a piece of picture wire. Ignite this and lower into a bottle of oxygen. Note how readily the wire burns and the globule of red hot iron that forms on the end.

3. Generate hydrogen and allow it to escape from under water. Hold a lighted splint over the escaping bubbles. (Fig. 1). As each one escapes it is ignited and explodes. This sounds like a miniature battle. Another way is to blow hydrogen bubbles and as they rise, set fire to each. (Fig. 2).

4. Dissolve some yellow phosforous in carbon disulfid and paint a sheet of paper with this solution. In a darkened room the phosforous will glow after the carbon disulfid has evaporated. Do not leave the solution or brush around. The bottle should always be tightly corked.

5. Dissolve 15-20 grams of lead acetate (sugar of lead) in 500 c.c. of water and place in a wide mouth bottle. Suspend in this liquid a piece of sheet zinc by a string. Allow it to stand for a day or so. By careful observation you will see the lead tree grow.

6. Alcohol from sugar. Dissolve 30 grams of table sugar (granulated) in 400 c.c. of water. Pour this into a flask provided with a stopper and delivery tube. Add ¼ cake of yeast and set aside in a warm place. It would be well to have the delivery tube dipt into lime water, so as to show that carbon dioxid is given off. Allow this to stand for a few days. You can then distill off the dilute alcohol. This is done by distilling about half of the liquid and discarding the remainder. It may be necessary to distill off half again before the alcohol is strong enough to burn.

7. Boil 10 grams of powdered nutgals in 80 c.c. of water. Filter after standing. There is now tannin in the solution. Add to this a solution of iron sulfate. Some inks are made in this manner.

8. Place a small piece of phosforous in a porcelain dish (free from water), and the same amount of iodine. The reaction proceeds by itself with the production of much light and heat.

9. Place a little powdered antimony into a jar of chlorin. It immediately catches fire and gives off a shower of sparks. Heat a piece of thin copper foil and plunge it into a jar of chlorin. Observe that it catches fire immediately, forming copper chlorid. Paint a piece of paper with turpentine and hold it in a flame until it begins to light. Quickly plunge it into a jar of chlorin. There will be a flash and great clouds of carbon are produced. Flowers, calico, etc., may be bleached by moistening and placing in a jar of chlorin.

10. Make an intimate mixture of equal parts of potassium chlorate and sugar. Set this in a pile and add a drop of sulfuric acid (concentrated). The mass catches fire at once and flares up.

11. A very striking experiment to illustrate the solubility of ammonia gas is to fill a flask completely with the gas and insert a stopper provided with a straight piece of tubing. (See Fig. 3). To this is added a piece of rubber tubing over which a clamp is placed. To this is attached another straight piece of glass tubing which dips into the bottom of a beaker of red litmus. When the clamp is opened, the water rises and the color changes to blue. This will take place sooner if water is put into the upper piece of tubing. (Fig. 3).

Contributed by
EDWARD MARENZANA.

LIQUEFYING A GAS.

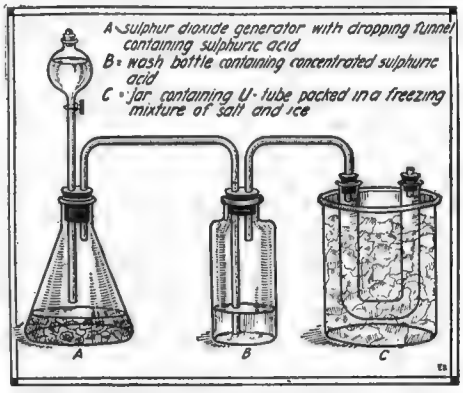
The actual liquefying of a gas is an experiment of great interest, and in the case of sulfur dioxid easy to carry out. The apparatus is set up as shown in the diagram. *A* is an Erlenmeyer flask carrying a dropping funnel and containing in the bottom a layer of sodium sulfite powder. The funnel contains a solution of sulfuric acid made by pouring the concentrated acid very slowly into an equal volume of water and allowing to cool. *B* is a gas-washing bottle containing concentrated sulfuric acid. *C* is a battery jar containing a U-tube packed in a freezing mixture of salt and ice.

After the set-up has been made allow the acid from the funnel to drop slowly upon the sulfite. A rapid evolution of sulfur dioxid gas will at once begin, and in passing thru the U-tube the gas will be condensed to a clear colorless liquid.

Freezing Action of the Gas—Pour a little of the liquid gas into 10 cc. of water in a small beaker. The mixture, upon stirring, will immediately crystallize to a solid mass.

Place a little water on a block of wood and upon it set a small beaker containing a little of the liquid gas. The rapid evaporation of the liquid will produce intense cold and freeze the beaker to the block.

Contributed by FLOYD L. DARROW.


A Sulphur dioxide generator with dropping funnel containing sulphuric acid
B wash bottle containing concentrated sulphuric acid
C jar containing U-tube packed in a freezing mixture of salt and ice
A
B
C

Apparatus Set Up for Experiment in Liquefying a Gas.

TO GIVE PLASTER FIGURES APPEARANCE OF MARBLE.

Put one ounce of grated pure curd-soap into four pounds of clear water. Dissolve in a well-glazed earthen vessel. Then add one ounce of white bees-wax cut into thin slices. As soon as the whole is incorporated it is ready for use. Having well dried the plaster figure before the fire, suspend it by a piece of twine, and dip it once into the above varnish. Upon taking it out the moisture will appear to have been absorbed. In about two minutes stir the solution and give the figure another dip. Two dips are usually sufficient.

Allow the figure, carefully covered to protect it from all dust, to stand for a week, then with a soft muslin rag, or cotton wool, rub the figure gently, when a most brilliant gloss will be produced.

Contributed by
WALTER CHAS. MICHEL.

METHOD OF TESTING WOOLEN AND COTTON THREADS.

Take a few threads of the material to be tested and place in a test tube with enough nitric acid to cover them. Bring just to the boiling point over a flame and allow to cool. Pour a small quantity of ammonium hydroxide in the tube and note the change. If the liquid is not changed in color the material is cotton, but if the liquid assumes an amber color the material is woolen. In either case dense white fumes of ammonium nitrate will be evolved from the tube.

Wool contains much nitrogenious matter while cotton contains none. This accounts for the change. The above is a sure test. I have used it repeatedly.

Contributed by
JOHN ELIOT CHRYSTAL.

RADIO DEPARTMENT

Some Long Distance Radio Telephone Tests

By ROBERT F. GOWEN*

A SERIES of radio telephone tests and experiments by the writer performed during the months of December and January have produced some results which may be interesting to the readers of the ELECTRICAL EXPERIMENTER. The results are interesting, not only because of the records made, but of the peculiar conditions under which the experiments were performed.

The transmitting equipment consisted of a standard one kilowatt deForest Oscillion panel transmitter which is designed to work on large ship type aerials on wave-lengths between 500 and 1000 meters. This transmitter uses two ½ kilowatt power tubes for the generation of the high frequency currents. The plate current of these tubes is supplied from a motor-generator set which delivers a voltage of 1500. The tubes are of a new type made of Pyrex glass and the plates are of Tungsten so that external cooling is not required. The tuning is done by means of a variable sectional series condenser and by varying contact clips on a helix in the rear of the panel. The circuit employed was of the standard deForest single tuned type with capacity coupling between the grid and plate circuits.

A special new type of modulating circuit developed by Mr. C. V. Logwood was installed, the novelty being in that both the grid and plate circuits of both tubes are modulated by the voice currents at the same time. Continuous wave telegraphy is accomplished by making and breaking the grid leak circuit and a modulated wave was added by substituting with a switch, a buzzer and key in place of the microphone.

The transmitter was installed at the home of the writer in Ossining, N. Y., and connected to a comparatively small aerial, four wires 170 ft. in length with a spacing of 30 inches and with an average height of 55 feet. A 60-foot lead-in was tapped off the end nearest the station and brought to the transmitter through a hole in a window pane. This aerial has a capacitance of approximately .0007 mirco-farad and a fundamental wave-length of about 355 meters.

The ground system consisted of 84 square feet of copper sheet buried beneath the foundations of the operating room about 8 feet below the transmitting apparatus. There were also additional grounds to the water pipes, gas pipes, heating apparatus, etc., of the house.

Upon installation, no difficulty was experienced in making the transmitter operate successfully on 750 meters for tests and demonstrations with the deForest laboratories at High Bridge, but when later, experiments were made to cause the set to oscillate at 200 meters in order to work with the amateurs, it was found that the constants of the circuit were such as to make it decidedly unstable at this high frequency. After a good deal of experimentation and adjustment, however, fairly good results were obtained at a wave-length of 330 meters which, it will be noted, was below the fundamental of the aerial.

Photo Above Shows the Author, Mr. Robert F. Gowen, the Radio Engineer Who Talked 1,500 Miles on Less Than 300 Watts, or About One-Fifth of a Watt per Mile. He Is Shown Holding a New De Forest 1 K.W. Transmitting Bulb or "Oscillion." Photo Below Shows Amateur Radio Station of Mr. Trump at Topeka, Kansas. He Received the 1,500 Mile Radiophone Speech Sent Out by Mr. Gowen at Ossining, New York

Using this wave-length during December the writer attempted to communicate with amateurs in the vicinity of New York and found great difficulty in making the telegraph signals heard because of the extremely sharp tuning of the emitted wave and also because very few amateurs listen on wave-lengths over 250 meters.

On the 330 meter wave-length the transmitter would put but 2.4 amperes into the aerial with an imput of 300 watts, tho a maximum of 2.6 amperes could be obtained with an imput of approximately ½ kilowatt. Owing to the unstable conditions caused by the circuit constants the oscillator had very poor efficiency and about January 1 the writer was surprised to have a report that the signals were being heard at Utica about 175 miles away. Mr. Benas at Utica reported by radio telegraph and by letter that the music sent out at the Ossining station could be heard 100 feet away from his telephone receivers when using a two step amplifier, so that in two instances, his friends there had used it as a dance orchestra.

It was apparent from this report that, altho it was difficult to get amateurs to listen and answer the calls on 330 meters, when the signals were once tuned in, they were very loud. This incentive prompted the idea of working later at night when the amateur interference was less, and shortly thereafter Radio Station 8ER answered a call and reported that they were at St. Mary's, Ohio, more than 600 miles away.

Continued efforts in adjustment of the circuit and methods of calling them brought in reports from many stations thruout Ohio, and Indiana. Reports of successful reception of the speech were received also from Wakefield, Massachusetts, Gaffney, South Carolina, Napanee, Ontario, about this time, increasing the distance to about 750 miles. Subsequently a letter was received from the operator on a yacht 300 miles south of Jacksonville, Florida.

(*Cont. on page* 1326)

Photo from Underwood & Underwood

Robert K. Trump, 21, a Former Sailor Living in Topeka, Kansas, Overheard Phonograph Music and Conversation Between Robert F. Gowen, Engineer of the DeForest Radio Telephone and Telegraph Co. and R. H. G. Matthews of Chicago

*Engineer deForest Radio Tel. and Tel Co.

Music 400 Miles by Radio

If you haven't your favorite jazz melody and if there isn't one within 400 or 500 miles, don't let that worry you. Just send a radio to the nearest wireless station, and have them put the desired record on the instrument, put your receiver in operation, and you have it. Everyone knows the wireless has proven a successful invention, but very few know all the uses it may be put to. The other day L. W. Elias, officer in charge of the Chicago U. S. Radio Station, was successful in sending a complete musical program to Fort Sheridan's convalescent soldiers. When he had finished, to his surprise the operator in Detroit complimented him on his progress and advised Mr. Elias that he had connected his instrument to a transmitter and that over 100 people had heard his music. He was also told that everyone in Camp Grant had heard the same program. The apparatus necessary to transmit music in this manner is a phonograph with records, a transmitter, and receiver combined with a power plant connected with batteries. The transmitter consists of one oscillating and one modulating tube. Any amateur receiving apparatus within a radius of 400 miles can intercept the sound waves as they are sent on undampt waves of 700 meters. The Chicago Government Radio Station ranks first in all experimental work and the last rating was given 99.2 per cent. The photo shows L. W. Elias and the machine.

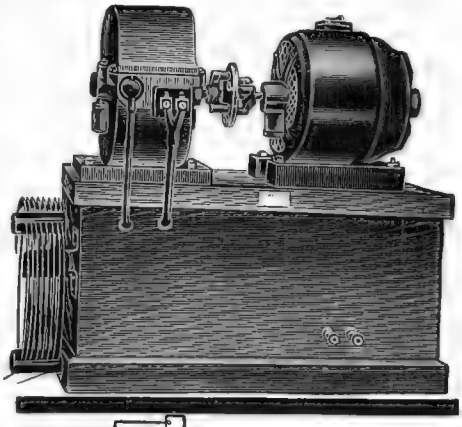
By Means of the Phonograph and Wireless Telephone Apparatus Here Shown, Dance Music Was Recently Transmitted 400 Miles by Radio to Some of Uncle Sam's Convalescent Soldiers. Photo (c) by U. & U.

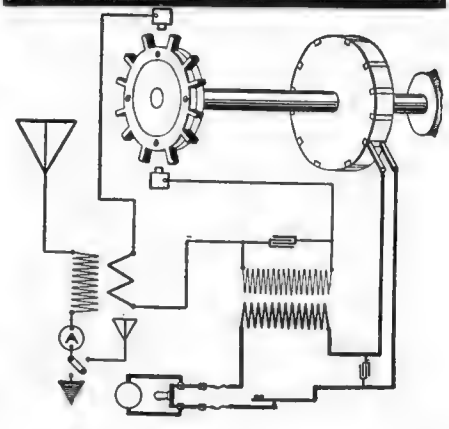
The wireless telephone is not so much of a novelty any more, altho of course, the apparatus is not to be had for a mere song. However, our radio experimenters, even the youngest, are rapidly becoming experts in the development and construction of simple apparatus, whereby it is possible to transmit articulately, the spoken word. In transmitting music or vocal records from a phonograph by means of the wireless telephone, there are several different ways in which the air waves set up in the phonograph sound chamber may be communicated or superimposed upon, the wireless telephone transmitting apparatus, and eventually to the antenna from which this is liberated into space, in the form of electro-magnetic waves in the ether. In some cases, the microphone of the modulating circuit of the wireless telephone outfit is placed in proximity to, or secured tightly to, the phonograph sound-box proper. In other instances, one or more microphones of the modulating circuit have been placed in the amplifying sound chamber of the phonograph, and this has been found to give very good results.

A microphone placed inside the doors or grill of the phonograph has many good points about it. This is so for one reason that the sounds created by the diafram of the phonographic sound-box have not their full vibrating timbre and sonority when they first proceed along the tone chamber, but receive their full sonority only after they have entered the larger amplifying chamber.

"Direct Current" Transmitter

A new radio transmitter has been developt by L. M. Cockaday, of New York, which operates on a direct current source of power, the system being such that it eliminates the motor-generator now used in connection with spark set transmitters.





New Direct Current Wireless Transmitter Giving a Clear Note Equivalent to a 500-Cycle Synchronous Spark Set. Its Secret Lies in the Use of a Rotary Synchronous Spark Gap and Interrupter in Place of a Fixed or Stationary Spark Gap and Ordinary Interrupter.

In the primary circuit a rotary interrupter is used in series with the primary coil of a step-up transformer, in combination with a synchronous rotary spark-gap in the secondary circuit, as shown in the diagram.

The relative positions of these two wheels are so adjusted that as the interrupter closes the primary circuit, the condenser in the secondary circuit can discharge only at its maximum capacity; that is to say, the spark-gap comes into sparking position just as the interrupter opens the primary circuit, thereby obtaining its highest efficiency.

The interrupter successively opens and closes the power circuit a sufficient number of times to obtain a clear 500 cycle tone which is always steady.

Audions on Alternating Current Again!

As several readers have inquired about using audions on A.C., and how to get rid of the hum, etc., we referred these to Mr. Elliot A. White, author of the article "Operate Your Audion on A.C.," which appeared in the July issue. Here are some valuable pointers from Mr. White:

"In reply to your queries, I understand your first paragraph to mean that the queries concern the use of alternating current for the *filament only*.

"My experience has been that it is easier to use A.C. on the plate than on the filament, because in the former case the large condenser across the leads from the rectifier keeps the 60-cycle hum out of the circuit. It is more difficult to use the A.C. for the filament only, as it is sometimes hard to get rid of the hum. However, I have personally, as I said in the article, used the A.C. for *both* plate and filament, both separately and together, and got rid of all noise. A friend of mine has also had success with it on the filament alone—'as silent as a church,' he told me. I believe the Navy used toy transformers for filament-lighting at 'Great Lakes' during the war, and I have also heard of its use by the Navy and by the Federal Telegraph Company on the 'Coast,' so you see it can be done all right. I suspect the trouble in the cases you mention is probably due to the Experimenters themselves, as I suggested in the article, for I by no means claim that the device is 'fool-proof.'

"However, you might call their attention to several important points, all of which were treated in the paper: 1. The connection to the balancing resistance across the filament must be properly adjusted. 2. Connections from the tuned circuit to the detector must be made exactly as in the illustration ('ultraaudion' hook-up, the secondary being connected to grid and plate, not grid and filament). 3. The tuning adjustments of inductance and capacities must be properly made, this being delicate, as I said. 4. Any foreign sources of interference from A.C. must be eliminated.

"If your complaining readers are correct as to 1 and 2, then their trouble is with either 3 or 4. Concerning these, I would refer them again to the article, particularly to the second and third paragraphs from the end. It is, of course, also possible (I know of one such case) that the Experimenters are getting *cross-talk* from near-by power lines to antenna outside the house, or from house wiring to the set inside, either by capacity effect or by direct induction. I should think you would find it difficult to handle these problems without being on the ground."

Photo at Left Shows the Famous New High-Powered Radio Station at Croix d'Hins, Which Is Located Just Outside of Bordeaux, France. It Has a Total Power Rating of Some 1,000 Odd Kilowatts. Photo at Right Shows Remarkable New Radio Receiver Which Automatically Rings a Bell Signal on Ship, When Another Vessel Is Sending Out an "S.O.S." Call for Help. This Will Avoid Delays in Answering Distress Calls at Sea.

Latest Radio News

THE accompanying photograph at the left shows the gigantic steel towers of the powerful Lafayette radio station of Croix d'Hins, located 15 miles outside of Bordeaux, France. This station, one of the most powerful if not the most powerful in the world, was started in 1918 by the U. S. Navy to enable radio communication to be carried on in a positive manner at all times with the American war vessels traversing the Atlantic Ocean and other waters.

This plant has since been turned over to the French government by special arrangement. There are eight giant masts, each rising 825 feet above "Mother Earth," which serve to support the antenna conductors.

When the armistice was signed the U. S. Navy Radio Department discontinued work on the stations, but the plant was completed by the Pittsburg-Des Moines Company for the French government.

This plant will have various types of radio transmitting equipment, including arc and spark sets with a total rating of some 1,000 odd kilowatts.

AUTOMATIC S.O.S. BELL SIGNAL FOR SHIPS.

The photograph presented herewith at the right illustrates a remarkable new radio invention which is said to pick up and translate "S.O.S." calls from ship stations and to cause a bell to start ringing in the station receiving the call. In other words, when a ship in distress sounds the S.O.S. call (the International radio signal of distress, to which ships of all nations pay strict attention under the present regulations, in order to try and speed toward the disabled ship and render succor, if possible), the radio signals, flashed out from the vessel in distress is picked up on the antenna of other ships within a radius of several hundred miles and if fitted with this apparatus the message of distress will give an audible signal on the bell at once, without taking a chance of whether it will be picked up by a radio operator "listening in." It has sometimes been the case that such signals have not been heard even by ships quite close to the vessel calling for assistance, owing to the fact that the operator may have been off duty at the time, or for some other reason.

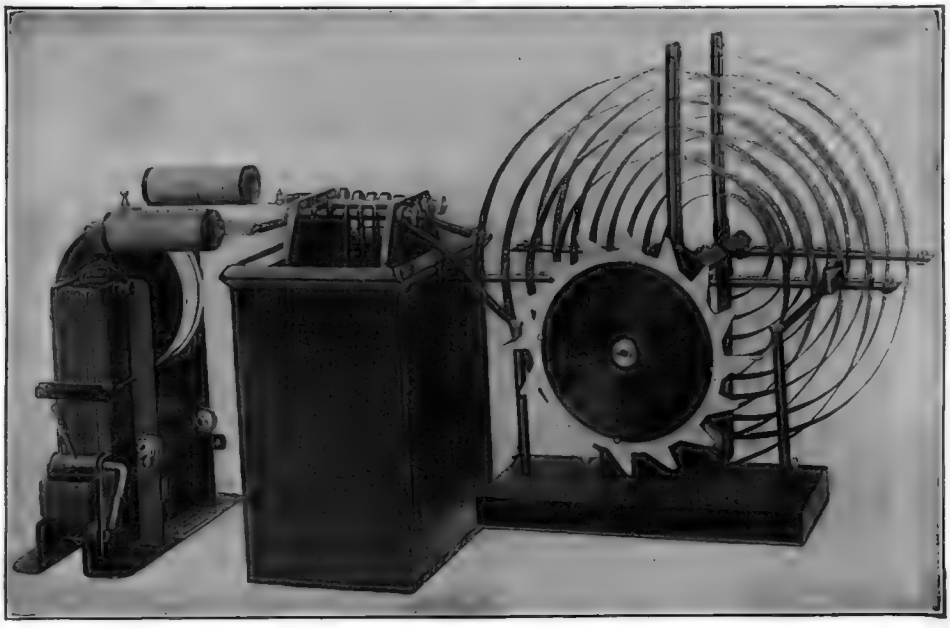
We have long advocated such an apparatus as this for receiving and interpreting "S.O.S." calls at sea, for many reasons. It is a simple matter now-a-days to rig up a positive working apparatus which, by means of sensitive relays and amplifiers, will serve to close a local circuit containing a sufficiently strong battery to actuate a call bell circuit.

The main purpose that the bell signal in this case serves is to call the attention of the radio operator in charge, and possibly the ship's commanding officer, to the fact that a distress signal is being received. When this has been done, the operator of course "listens in" in order to receive the further details of the distrest ship's location, which is given out by wireless both as to latitude and longitude.

New Amateur Wireless Transmitting Set

General amateur wireless telegraph stations are restricted to a transmission wavelength of 200 meters, and a Chicago concern has developed and placed on the market a wireless telegraph transmitting set designed to give the best results on this short wavelength. This set includes a transformer, condenser and oscillation transformer and a rotary spark gap, all of which are shown in the accompanying illustration.

The transformer is of the closed-core, air-cooled type with a double magnetic circuit. A feature of the construction is its magnetic shunt control, which protects the transformer from all undue current surges. The transformers are designed to be connected directly to a source of alternating current, no choke coils being necessary. Capacities of 1, ¾, ½ and ¼ k.v.a. (kilo-volt-amperes) are made, but the ¼ k.v.a. transformer does not have the magnetic shunt control. The center device in the illustration is the condenser. This is of the oil-immersed type. There are ten terminals arranged so that the capacity can be varied from .0018 to .009 microfarad in single steps of .0009 microfarad each. One k.v.a. = 1000 watts at 100 per cent power factor.



Complete Amateur Radio Transmitter Designed for 200 Meters Wave Length. Built in Sizes from ¼ to 1 K.V.A.

Selective Wireless Control

By EVERETT LEO DEETER

HUNT up all your old telegraph coils, your extra Audions (you who have fat pocketbooks), and prepare to settle down to business, for here's a new stunt to try, and you can become a great "professor," or a "wizard," by amazing people in your own home town by the act of controlling numerous distant apparatus, simply by pushing a button on your radio-sending outfit.

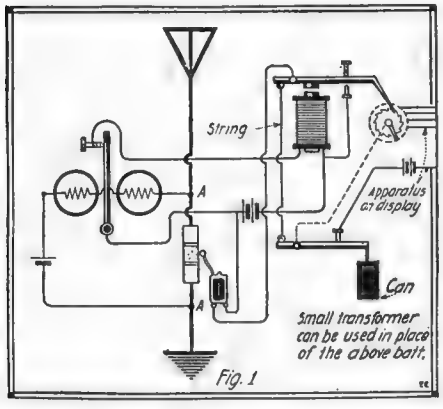


Diagram Showing Connection of Coherer and Decoherer With Polarized Relay, and Also Special Selective Relay Fitted With Dash-Pot.

By following the construction details given herewith a wireless control board which works very well can be easily constructed, and by its use the amateur can operate any certain apparatus connected to the board without first operating others, thus making it a true *selective control.*

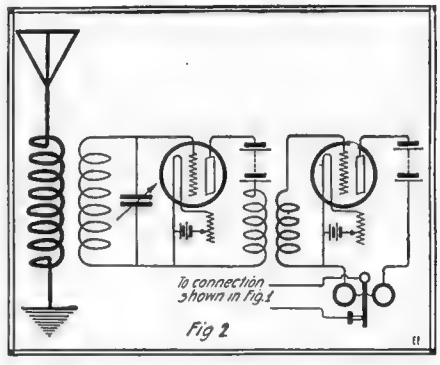
Now if you are done with that message we'll go to work—yes, tell your neighbor to come over, too, for after he sees your's he'll want one, too. First we will see for ourselves how the thing works.

For simplicity we will consider the use of a coherer—the poor nut may be forced to use one in his actual model—and if he spent all his money for auto cable to try out the "underground trick"—but, anyhow, a coherer works quite well. But don't let anyone catch you when you file up a nickel and dime for filings. And don't break up the family thermometer for a tube, because it's too small inside, and if you were to get the "flu" your temperature might go a mile high and it would be impossible to get it down again—anyhow you could use it to hang your aerial on.

Here we go—get your electrical dictionary and turn to diagrams—make sure you know what sign represents a relay, coherer, battery, etc., as you hardly ever see this one, and then after six or seven hours of real study we can almost realize the following facts:

If you focus your luminaries on diagram No. 1 and was just to imagine that some poor jay wireless amateur was to send out a right smart wireless wave, which was by decrement and other complicated mathematics of the same metric wavelength as that of our elaborate de-cohering outfit, why then our clumsy antenna would probably make a successful attempt and "down the thing." Now if the wave gets thru the coherer to the ground it causes the filings to get close enough together to lessen their resistance, and then things begin to happen. When the platinum (if you're rich) points close, of course the juice goes thru and makes the magnet pull down the arm which operates the sprocket wheel, in turn operating the commutator or the switch controlling the display apparatus. If you think you now understand all you've been over, proceed to diagram No. 4 also. If you don't proceed anyway—it'll do your think tank good. When the arm is down it makes contact to J, and this gives a little stingy juice to the bell, what there is of it, which hits the glass tube of the coherer and knocks the filings apart, ready for another "jazz." But this is not all the clumsy brass arm did—the string seen between C and M pulls the arm B, and out at the end where the plunger R is connected at O there is quite an emotion as the arm drops thru a long arc, which may be varied by sliding the arm at N.

The plunger R is connected to a small air-tight vessel partly filled with water, and this floats upon the water enclosed in the larger tin can P (see Fig. 5-A). Now when the arm comes down the "ship sinks," and the small vessel goes under and if left alone it always takes a little time for it to come to the top, being partly filled with water. Of course, if the arm is constantly being pulled down the float is also pulled under. Now as long as the float is not entirely up the main circuit for the display apparatus is open and therefore they do not operate. But when the arm is up then the circuit and the apparatus circuits operate on the point the switch is left on.



Amplifying Circuit Provided With Two Audions Connected to Sensitive Polarized Relay, Which in Turn Actuates the Special Selective Relay Here Described.

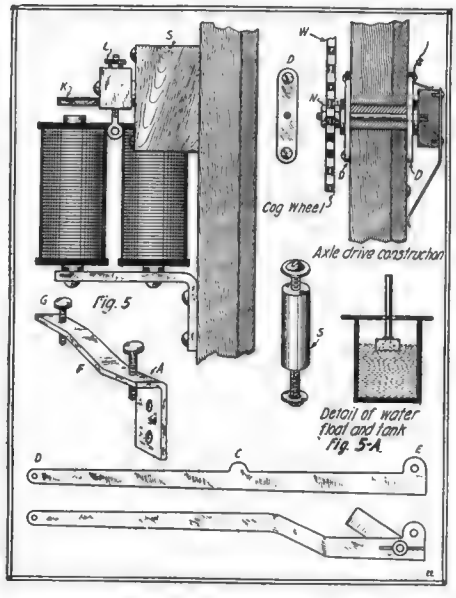


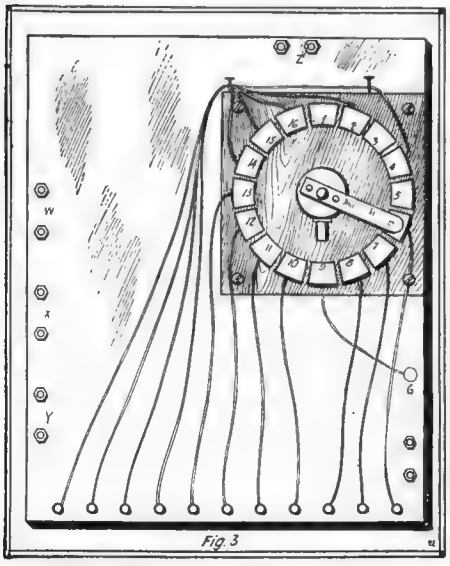
Illustration of Details to Be Followed In Constructing the Selective Radio Control Relay Here Described.

Now for the conclusive diagram, No. 3. This shows the back of the control board, and mainly the circular switch. Now supposing we had No. 1 of the switch connected to an electric train or street car, No. 3 to a little windmill, No. 4 to an electric light, No. 5 to an electric cannon, etc. We want to cause No. 1, the train, to operate. We push our transmitting button four times and toot-toot she goes. Now we are asked to shoot our cannon, No. 5, and all we have to do is to push the button four more times and bang! For No. 10 we would now push five times, etc.

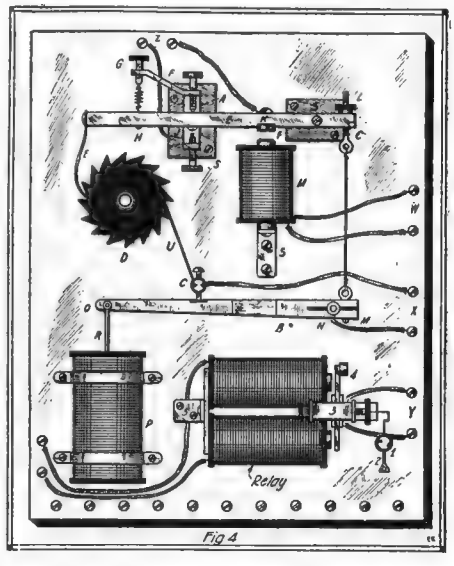
Two and ten on the switch are stop blanks, while 16 can be a place where they all operate, making the segment of eleven narrow strips, not touching one another and connected to all other segments of the switch.

Retire for the night now, for you'll need all kinds of strength and ability, as well as

(*Continued on page* 1334)



Rear View of Selective Relay Switch-board



Front View of Selective Relay Switch-board.

War Versus Pre-War Apparatus

By "SPARKS"
C. E. Radio, U. S. N.

THERE seems to be a marked tendency among radio experimenters of the present to lay their hands on the new developments in radio apparatus, particularly as applied to various receiving instruments which have been brought out during the World War. From what I can gather from various publications and l tters from the Amateurs, a great demand has arisen for the most modern of apparatus. This demand reflects a spirit of progressiveness in the Amateur, it is true, but there is a limit to all things, and the adoption of all the new and fancy frills which are being described from time to time will lead to a limit where the distressing facts are all too plain—that the little old stuff that we used to "gather in" the signals with, was far superior to seventy-five per cent of the war apparatus.

I have had considerable experience with the majority of apparatus which was brought out during the period of hostilities, having used practically all the latest developments under typical operating conditions, and for the benefit of those whose longings for "Navy VT's," "loop antennæ," etc., are getting the better of common sense, let me outline a few of the results I have obtained with new and marvelously efficient (?) *war radio apparatus.*

AERIALS.

Let us start at the top, this being the aerial, of course. Before 1917 we Amateurs used the good old inverted "L" or "T" type, flat-top antennæ of the four- or six-wire size, elevated from thirty to fifty feet, and we got GOOD results. A certain Portland (Ore.) Amateur, regularly communicated with a station in Los Angeles and with a Reno (Nev.) station also. Chicago Amateurs were heard up to one thousand miles, and the east coast stations were easily heard in the Middle West and South. *All this with one K.W. or less and on two hundred meters!* In my tests, I used an antenna of the typical flat-top "T" type, three hundred feet long and eighty feet high, four wires, and with a two-kilowatt, five hundred-cycle set, was able to cover twenty-two hundred (2,200) miles at night on six hundred meters, at sea. Substituting a loop antenna of four hundred ninety (490) meters natural period, I obtained a radiation of seventeen amperes, but my signals were *only* heard at a distance of two hundred seventy miles. The vessel with which I carried out these tests used an Amateur tubular audion bulb, with no amplification; with his Navy VT he could hear me very faintly at two hundred forty miles. I made several similar tests, elevating the loop, etc., but on no occasion was I able to do better. On the other hand, the loop antenna for receiving is not at all bad. I picked up signals from Lands End, England (GLD). at seventeen hundred miles, with one tubular bulb (eleven hundred miles on a Navy VT), and merely placing the loop on the bridge. The chief objection to the loop antenna for reception in Amateur Stations is its marked directive effects. In some cases this would be an advantage, in cutting out interferences, or receiving signals from but one general direction and its opposite, but very few Amateurs will care to limit their receiving possibilities to but one or two points of the compass. The loop invites experimentation, but don't be so all-fired het up about adopting it without trial in your proposed station. Stick to the flat-top, inverted "L" or "T" types—they aren't going to be back numbers at all.

AS TO APPARATUS.

Now as to the apparatus itself. A new form of layer wound inductance has made its début, in the form of pancake loading coils, and is also being embodied in several forms of loose-couplers. The coils have given good results, when used as loading inductances and coupler coils, and have the advantage of taking up much less space than the old type of cylindrical tube windings. It is also easily possible to incorporate these coils into panels, which are very popular, and make a neat job of it. The layer wound coil—*IF* wound with an offset winding (honeycomb coils) is a distinct step forward, and full credit should be given it. Experimenters, in buying, however, should demand this offset winding which makes the coils what they are—extremely neat, compact and efficient little units.

A word now about *capacity coupled* tuners. These were tried on various vessels, and in shore stations, but were found to be impractical for spark reception, due to their extreme sharpness of tuning, which made them poor "stand-bys." In certain cases the tone of the incoming signal was also distorted by them. For these reasons their adoption as spark receivers never became very popular, but in long wave undampt wave receivers they seem well adapted, for their sharpness is an advantage there, and it also seems that the more variables that can be crowded into an *arc set* the better it works. Capacity tuners, however, will never become popular in Amateur Stations.

In April
"Radio Amateur News"

Wireless in Modern Aircraft.
By A. J. Hall

The Priess Loop Set, Part IV.
By W. J. Henry

New Facts About the Nauen Station.
By Dr. A. Gradenwitz

Aladdin's Lamp.
By C. S. Wolfe

A Resonant Transmitter.
By W. S. Lemmon, E.E.

Easily Constructed Radio Mast.
By E. L. Deeter

The heart of the receiving station draws our attention next. I have heard more Amateurs whine, sigh and express extravagant promises of reimbursement to anyone who would get them a Navy VT than desires for all the other new apparatus that has appeared. The prevailing opinion seems to be that for sensitiveness they are marvelous—unequaled! Where this idea ever found root is puzzling, in the face of the fact that the majority of tubes developed for war purposes were, and are, miserably poor bulbs in comparison with the tubular bulbs we had formerly used. This applies to their use as detectors—they make good amplifier bulbs when used with 150 to 300 volts, plate current—but where will the modern Amateur, even, get that voltage, D.C.? Batteries are out of the question, as is a motor-generator. We are mostly concerned with detectors, however. The war tubes were designed to combine ruggedness, reliable operation in inexperienced hands, with a fair degree of sensibility. In the last named requirement they did not exceed the specifications in the least. It is true that such bulbs require no variation of plate voltage and will operate over a moderate range of filament current fairly well, but the Navy VT's all require a plate voltage of from seventy to one hundred and fifty volts. I have used probably two hundred different Navy tubes at times, and have yet to find one which equals the little old "tubulars" for sensitiveness. A new bulb has recently come into prominence, which I have had no opportunity of trying out as yet, but which seems to be "the goods," as it is becoming popular with a great number of Amateurs. It requires but a low plate voltage not required to be varied and seems to promise much. Until I have had the opportunity of trying it out, however, I shall stick to the old "tubulars" for all around satisfactory work. I have tried the new bulbs as amplifiers, by doubling the plate voltage—sometimes even tripling it—and have found them to be excellent for that purpose, better in fact than the tubular bulbs, which are poor amplifier tubes.

All this crabbing would naturally lead up to the question of what I would consider a good Amateur Set for *receiving.* My idea is, after testing, planning, designing and trying all manner of sets for the past two years, to have a *short wave set,* with a range of one hundred and fifty to six hundred and fifty meters, to include both Amateur and Commercial marine waves, and get good efficiency on each. The circuits should by all means be *regenerative,* using one of the old tubular bulbs. If it is desired to amplify these sets, I would suggest a two-step amplifier using the new Amateur tubes. The transformers should perhaps be purchased until more data is published regarding their construction than is now available. The telephones should preferably be of the mica diafram type, or if the price is prohibitive a good two or three thousand ohm, double headset.

Besides the above set, all well equipt Amateur Stations should have a long wave set, capable of receiving the undampt wave stations. While personally I do not care for the sustained wave system, it seems to be the coming thing, so we must all keep up with progress. An efficient *arc receiver* would comprise a long wave coupler, capable of receiving waves up to ten thousand meters at least, two or three variables, mica diafram phones, and a good oscillating bulb with a modern oscillating circuit. A very good undampt wave set can be made from the unit inductances now on the market, layer wound as before described. Several reliable concerns are putting out such inductances in neat individual cabinets of varying wavelengths, so that the inductances can be placed next to each other and used as primary and secondary coils, varying the coupling by changing the distance between the coils. If a receiver such as this is properly made, very good results will be had with an antenna of one single wire, several hundred feet long, which need not be more than *thirty feet high.*

A good ground connection is vitally important in every case. Solder your ground lead to a water pipe, and make it of heavy cable. In addition, ground to everything within reach—steam pipes, etc. It all helps.

If care is exercised in the construction and installation of equipment, and instru-

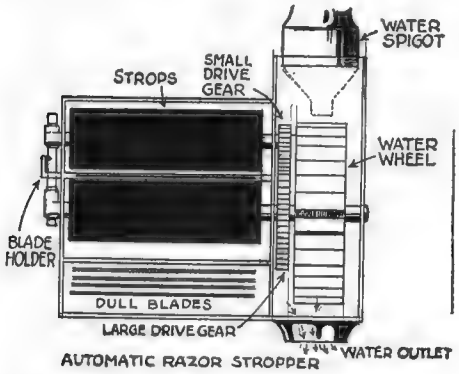
(*Continued on page* 1330)

What To Invent

By JAY G. HOBSON

THERE are several kinds of razor blade sharpeners on the market. Few of them have met with considerable success because they really sharpened as claimed. However, all of the various designs require the user to turn a small crank to operate the stropping element. It consumes enough time preparing one's face for the trying ordeal without having to stand around cranking the sharpener until the razor blade is ready to shave.

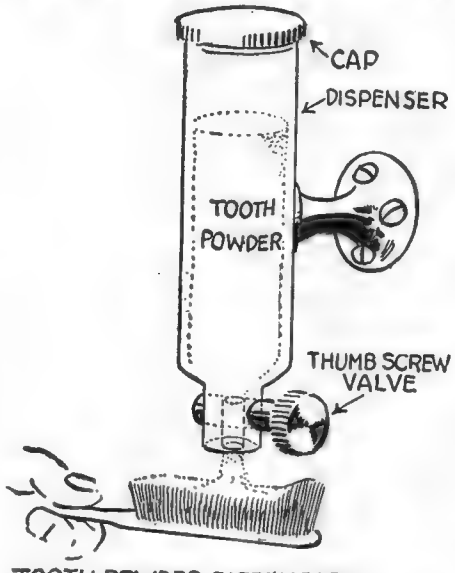
Why not construct an automatic razor blade stropper to be fastened on the water faucet as illustrated, one that will run when the water is turned on so that your razor blade will be nice and sharp by the time you are ready to shave. An efficient sharpener of this kind could easily be made as shown, with a light metal case, two round stroppers connected by small gears and operated by a little water wheel enclosed in part of the sharpener case. The blade can be arranged to strop on both of the revolving strops thru an eccentric connection with the blade holder. When you wish to shave fasten the sharpener to the water faucet, place the razor blade in the holder, turn on the water and by the time you are ready the blade will be in fine cutting condition to make shaving a pleasure. Every user of the modern safety razor would appreciate an improvement of this kind and gladly discard all other types for this design.



AUTOMATIC RAZOR STROPPER

And Speaking of Shaving,—Why Cannot Someone Give Us a Low-Priced Automatic, Safety-Razor Blade Sharpener Which Could Be Connected to the Kitchen Spigot. A Small Cheap Water Motor, Specially Designed for the Purpose, Would Rotate the Strop Wheels in Apple-Pie Order. Mr. Hobson Guarantees to Sell One of These to Every User of a Safety Razor in the United States and Foreign Countries,—the Bolshevik Regions Not Included!

During the influenza epidemic eating in public restaurants and cafés was rather a risky thing to do because public eating places are not careful in cleaning dishes and cups before using them again. In drinking hot drinks from the common cup people place the rim of the cup between their lips and draw the liquid into their mouths. This is a very easy way to catch the "flu" or some other contagious disease, of which there are many. To avoid this possible exposure a small celluloid (or even paper) lip and mouth protector could be made like that shown. It should be made to fit the rim of the cup snugly so that the contents of same could not run under and out upon the user's clothes. A little sanitary invention of this kind would undoubtedly meet with approval by thousands of folks who are particular about their health and desirous of avoiding any exposure to others' carelessness.



TOOTH POWDER DISPENSER

Instead of Losing About Six Tooth-Paste Tube Caps Every Month and Doing an Interminable Amount of Cussing About the Paste That Went to Waste or Soiled Your Clothes,—Why Not Invent a Neat and Cheap Tooth Powder Dispenser Like This? Zip—Turn the Thumb Valve and—Presto! You Get Just the Proper Quota of Tooth Powder on Your Tooth-Brush.

The average person becomes so adjusted to the present tooth brush and tube of paste or can of powder now in use that no thought of an improvement in this line seems to appear. However, on second consideration we can easily see that there is great inconvenience and waste in the seemingly efficient dentifrices of today. For example, remember the time you made a hurried trip to some distant point via Pullman, throwing necessities into your traveling bag as you ran out of the door. Recall how you had to stand on your head in the berth trying to find your tooth paste before retiring, and how very evasive it was. Finally you gave up hopes of finding it and went disgustedly to bed? On other occasions, at home when you were late for work and forgot to put the cover back on the tube of paste which was hard and useless when you returned home that evening? These experiences are a common kind to most of us. To overcome these difficulties and add to the pleasures of living I thought of what should prove to be a very welcome departure in every bathroom, every Pullman car, every public wash room and every place where dentifrices are used. As shown in the illustration my conception is in the form of a neat metal or porcelain bracket to which is secured a round tube or can embracing a removable top to allow for refilling the same, and at the bottom end would be arranged a small measuring cup or valve operated by the thumb and forefinger of one hand while the other hand held the toothbrush under the spigot to receive an exact amount of powder or paste sufficient for one good cleaning of the teeth.

As will be seen a little device of this kind installed in each bathroom, or Pullman car, would not only economize in the use of the preparation, but it would always be handy and ready for use of each member of the family. Having it ever before them with this kind of a slogan printed thereon, "USE ME TWO TIMES A DAY AND I'LL KEEP THE DENTIST AWAY," would remind them of the importance of keeping their teeth clean. An attractive device of this description would sell to most every home and probably be used extensively by some large dentifrice manufacturer.

Watching a fat gentleman bending over three times trying to reach his shoes to tie a broken or loosened string, while somewhat amusing, suggested an idea for a needed improvement in shoe laces. The present kind in universal use is really unsatisfactory for many reasons.

To begin with it is forever coming untied, wears out quickly, breaks just when we don't want it to, and causes flat feet because there is practically no give in the string when we walk, run or jump. Raising up on the toes in walking causes the strings to force the arch of the foot downward instead of allowing it to follow the motion forward as is natural when walking barefoot.

METAL SHOE LACE

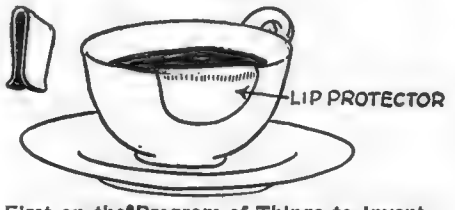
Ever Try to Lace Your Shoes in a Hurry? This Includes Ladies and Gentlemen, as Well as the Little Folks. Here's the Author's Suggestion: Do Away With the Everlasting String Laces Which Are Forever Losing Their Tips, and, Instead (When They Are Manufactured), Get a Dozen or So of These Spring Lacers,—and Besides, Your Foot Can Really Have Free Movement in This Expansible Shoe Top! Not Bad, Eh?

So an improvement in shoe laces is in order. One that seems practical to me could be made of a small, flat, adjustable bar or strip of metal with a stout coil spring concealed inside. This little bar is cut in the middle to allow for expansion and adjustment to shoe. At either end of this flat, hollow bar would be a blunt hook or catch "U" shaped and only large enough to fit into the eyes of both sides of the shoe as illustrated.

The small coil spring pulling on both ends of the flat bar would force the shoe sides together and hold them as securely as a shoe string, but, in addition, this improvement would allow for a free movement of the foot when walking, thereby preventing much of the present day foot troubles. A practical article of this kind should sell rapidly and be adopted by the large shoe manufacturers.

(This is the third article by Mr. Hobson. The next one will appear in the May issue.—EDITOR.)

LIP MOUTH GUARD



First on the Program of Things to Invent,—We Have What Mr. Hobson Suggests for a "Lip and Mouth Protector." Afraid of Catching the "Flu" or Some One of 57 Odd Fevers? Carry a Little Lip Protector With You and Slip It Over the Edge of the Cup Where the Nasty Little Germs Are Wont to Sleep Until You Drink, and Then, Good Night! Yes, We SHOULD Have Them!

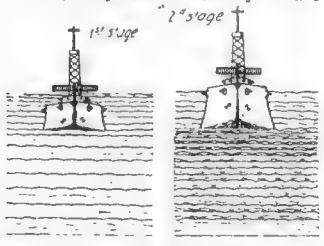
Copyright—1920—by Jay G. Hobson.

LATEST PATENTS

Theatrical Appliances.

(No. 1,324,680, issued to Langdon McCormick.)

This patent relates to a method of producing illusionary effects whereby, ships and other objects are

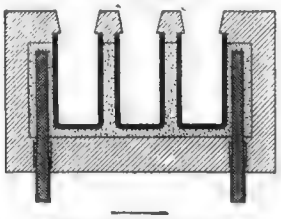


made to rise and increase or decrease in size and move forward at the same time, to give the effect of the ship or other feature moving toward the front of the stage. A large number of moving platforms cause the illusion effect to be more pronounced, at the same time a wider sea area toward the rear of the ship is effected by gradually elevating the waves, causing the illusion effects to take on the aspects found in nature. In actuality, the ship moves forward for about 10 ft.

Electric Furnaces.

(No. 1,324,156, issued to Felice Jacoviello.)

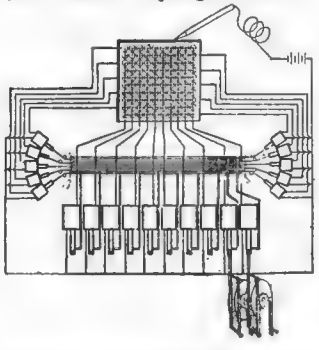
This latest invention is an electrical furnace wherein a series of grafite crucibles are imbedded in powdered coal or grafite, thus connecting them in series. The pipe or conduit communicates with the upper portion of every crucible. Molten metal can be poured from all of the crucibles at the same time. Great heat is produced in this furnace because of the relatively high and low conductivity of the alternate layers forming the grafite crucibles and the intermediate packing.



Electric Keyboard.

(No. 1,311,384, issued to William F. Drew.)

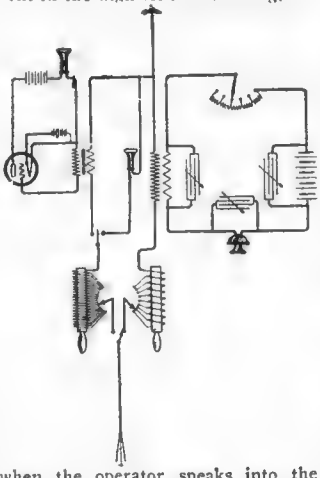
This does not relate to calculating machines only, but includes typewriters and the like. We shall describe the adding machine herewith. It consists essentially of ten solenoids which operate the adding machine levers. In addition, there are ten more solenoids connected to a tier of the same number of plates of slidable nature in the series. When, therefore, electrical contact is made by means of the stylus, two solenoids are immediately actuated. One draws the slidable plate of that series so that the plunger can only descend a definite distance, and the other system causes the plunger to descend.



Wireless Transmitter.

(No. 1,315,197, Issued to Earl C. Hanson.)

This patent is the latest for transmission of energy by means of electrostatic and electro-magnetic induction. It employs audio frequency radiation in contrast to the common radio frequency methods now used. It is extremely simple and can be controlled to such an extent that detection beyond the distance predetermined is impossible (according to the inventor). It consists of two reactances into which are placed iron cores; for sending a telephone coil is used, shunted by a variable condenser. The transmitter and battery are likewise shunted by variable condensers. Thus, the direct current, practically constant, induces no current in the high tension winding, but

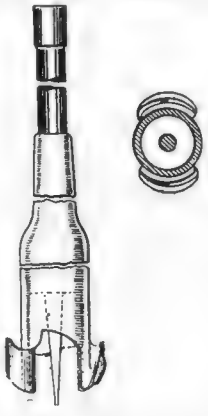


when the operator speaks into the transmitter he varies the resistance, and a considerable potential is imprest between the antenna and the ground. For receiving, a similar iron core reactance is used and is either connected directly thru a receiver or thru a vacuum tube for the purpose of amplification.

Battery Connector Remover.

(No. 1,316,485, issued to Fremont S. Kay.)

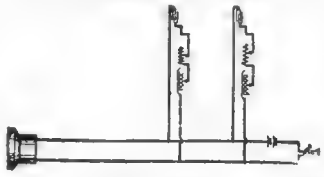
This patent is very clever and novel. Heretofore, in order to remove connectors from storage batteries and the like, it has been necessary to destroy the posts by drilling them out. This device, however, leaves the center post intact, removing only the connector without injury to the original posts. It should meet with favor with all storage battery repair men. The tool when operated cuts two concentric zones. The inner cutter clears the solder from the periferal surface of the posts of the battery, while the outer cutter clears the solder from the wall of the eye on the connecting strip. In this way the post and connecting strip are completely saved.



Eliminating Undesired Vibrations.

(No. 1,319,521, issued to R. A. Fessenden and F. H. Leslie.)

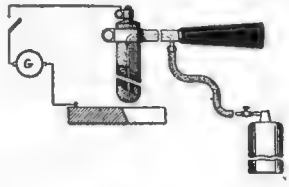
This patent is for sound producing bodies, such as diaframs, and its object is to suppress any desired extent of vibration frequencies which are not wanted. The presence of natural vibrations are very objectionable even in telephony, as a result of which the higher tones of the voice are unduly strengthened tho still permitting speech. If used in submarine signaling they would not transmit articulate speech, so by properly proportioning self-induction, resistance and capacity in the circuit, the amount of sound absorbed can be regulated and the diafram then made to vibrate substantially correctly over an entire range of frequencies, whereby clear, sharp, articulate speech can be heard for distances of five miles, via the absorption system, whereas, prior to this only indistinct sounds were heard.



Metal Cutting.

(No. 1,324,337, issued to R. E. Chapman and J. W. Kirk.)

A very clever patent was recently granted to the above mentioned individuals on apparatus for cutting metals. It is of the simple arc-forming type in which a carbon connected to a generator creates an arc at its point of contact with the metal to be cut. The center of this carbon, however, has a hollow bore

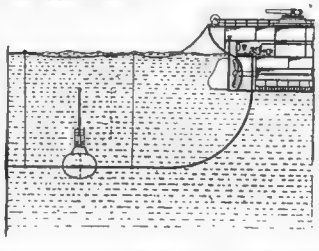


running thru it, to which is connected an oxygen supply tank; thus when the arc is started and the metal commences to fuse, advantage is taken of the better cutting qualities under the oxygen stream. This arc, according to its inventor, will operate as efficiently under water as above.

Submarine Boat Detector.

(No. 1,321,998, Issued to Giovanni Emanuele Elia.)

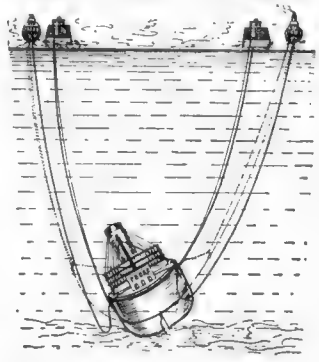
It consists of a long rubber hose about one-half inch in diameter suspended from a series of small buoys at a predetermined depth. This rubber hose may be quite long and as it is comparatively light, does not cause any great resistance upon the progress of the ship. Should the submarine now run into the hose and cut it, the sudden outflow of water which has been pumped into it under pressure, would be instantly noticeable on the vessel's indicating apparatus.



Ship Salvaging.

(No. 1,324,336, issued to J. T. Breneman.)

This is another of those patents which are planned to salvage sunken wealths and treasures. The patent, however, has the drawback in that the exact position of the ship must be known before further action can take place. Essentially, it consists of a method of dragging a cable over the bed of the river until it comes under the stern of the vessel. This cable is then replaced by a heavy chain. Immediately another chain is thrown across the top of the vessel so that it will lie perhaps 100 feet forward of the position of the first chain obtained. This second chain is connected with the first chain by a block which allows itself to slide downward only. When, therefore, the second chain is tightened, it forms a complete harness around



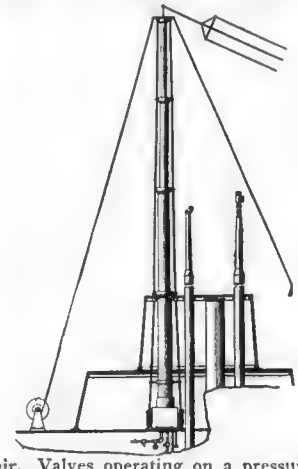
the vessel, gripping it firmly. As many of these chains are lowered as required in each case; the second chain only does the lifting, the first chain going under the bow and acting as the gripper.

A float actuated by hydraulic elevators then raises the vessel. As will be seen, the vessel for the successful operation should be in an upright position or nearly so.

Telescopic Tower.

(No. 1,325,053, issued to F. C. Steidle.)

This invention is the latest in telescopic towers for submarines and other uses. It is absolutely watertight and air-tight and its telescopic means is accomplisht by comprest



air. Valves operating on a pressure principle cause the first and lowermost section to rise, carrying with it all the other sections. When this reaches its extreme height the increase in air pressure causes the valve to open and the second section rises, and so on until the last is completely elevated. It also carries with it guys so that there is no danger of it being damaged during the process of extension or when storms are encountered at sea.

WITH the AMATEURS

Our Amateur Laboratory Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of apparatus unaccompanied by that of the owner. Dark photos preferred to light-toned ones. We pay $5.00 each month for the best photo or photos and $2.00 to each "Honorable Mention." Address the Editor, "With the Amateurs" Dept.

"Amateur Electrical Laboratory" Contest

THIS MONTH'S $5.00 PRIZE WINNER— PAUL WALTER

I SUBMIT herewith, photos of my Electrical and Chemical Laboratory. I do my own photo work and produce many odd effects with my home made apparatus and am equipt to enlarge, reduce and copy anything from an atom to a battleship. I manufacture a glue which will mend anything but a broken heart.

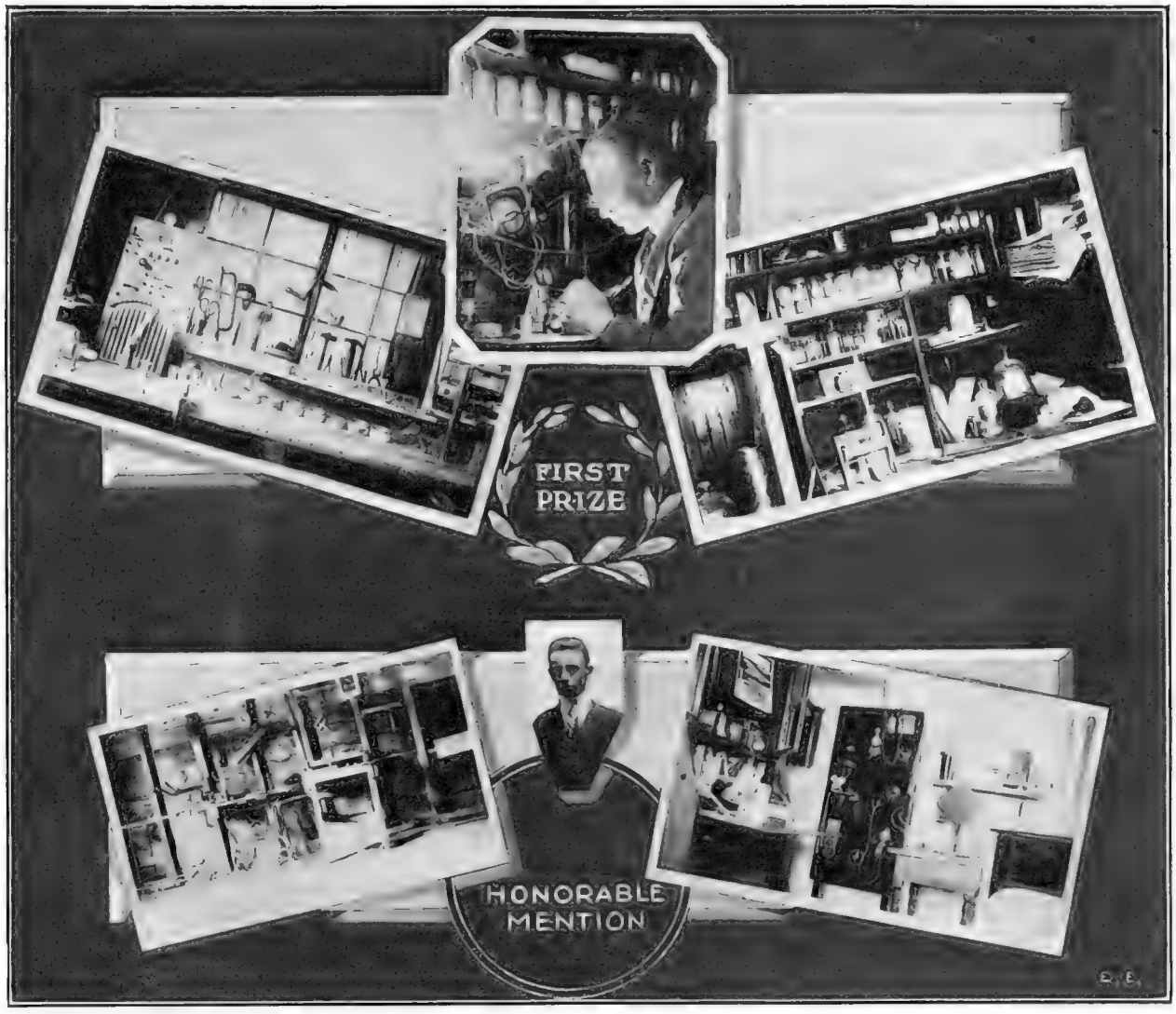
I have a motor-driven chuck upon which I turn up many things to be used in the making of coils, apparatus, instruments, etc. It will drill holes in any metal or wood and can be used to polish brass parts. This little tool is really necessary to any laboratory. A good asset for a well conducted shop, is to have everything arranged in some systematic order, so that when a fellow is working or has an idea, he will not be discouraged or tempted to be careless because the tool he wants is not handy, or the piece of material he needs is way down under some transformer iron. I have everything labeled and in plain view. Each screw and washer has its special place in my shop and I don't have to stop my work to look for an article. The result is that I get something done, because things are where they suggest their use.—Paul Walter, 2725 Main St., Ocean Park, Cal.

HONORABLE MENTION, JOHN G. SPOTTON $2.00 PRIZE PAID EACH "HONORABLE MENTION"

I WISH to show in this article what can be accomplisht in a limited working space. I only have a small corner in a room. The apparatus that are permanently mounted, are either on the table, the wall, or the switch-board. On the latter, I have a lamp, battery-fan, ignition coil, telegraph apparatus, "shocker" and a motor. These are controlled by a selective switch. The "juice" is obtained, at present, from dry cells. These are controlled by rheostats and by a switch, so that any number may be used.

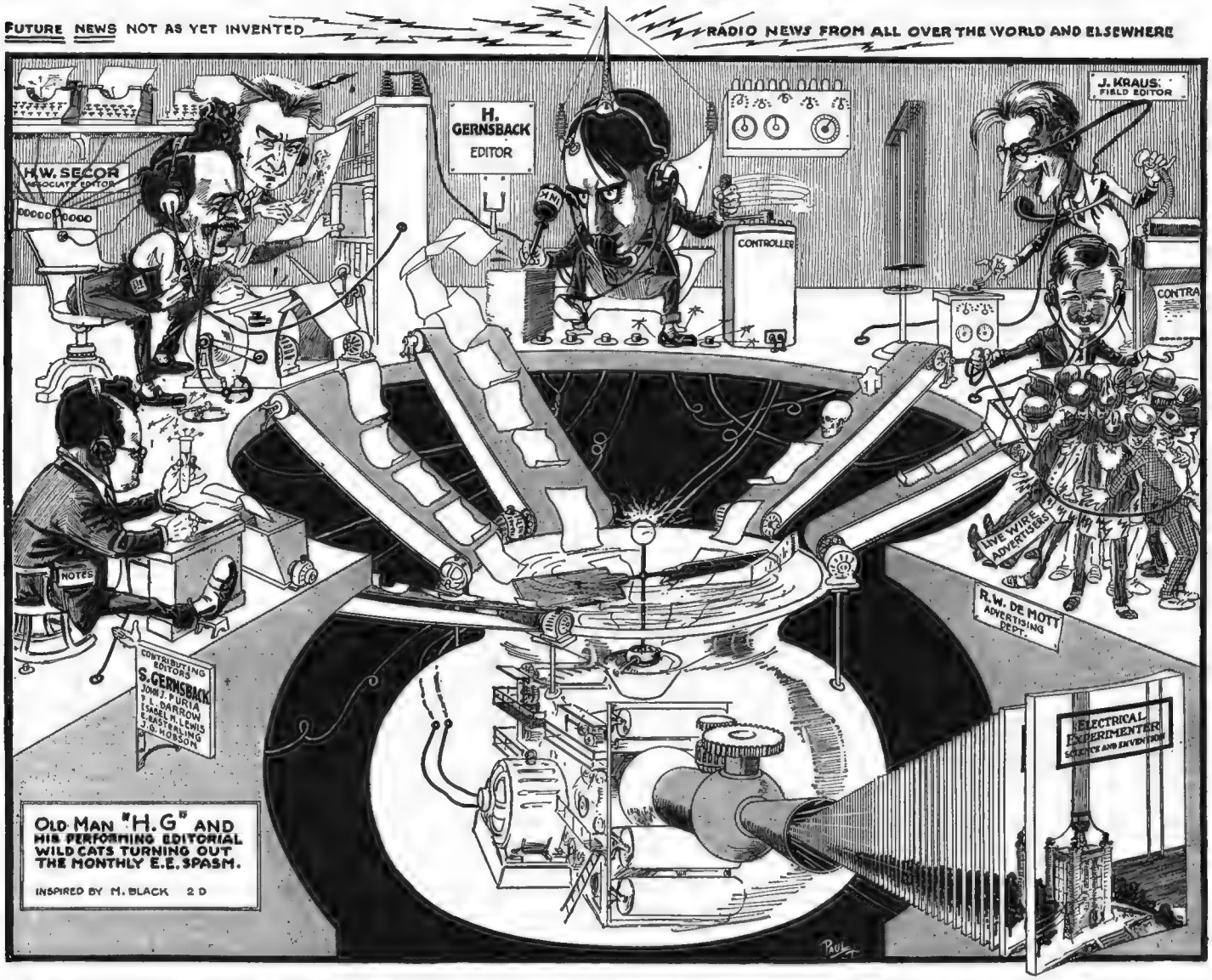
A good feature, is the combination telephone-telegraph line. For telegraphy, I now use a key (mounted on the table) Radiotone, condenser, and Pony receiver, while at the other end, a friend has a regulation Morse telegraph outfit. For phoning, I use a microphone, designed from one shown in the December, 1916, EXPERIMENTER—a phone and bell. On a shelf is an arc light run by 110 volt A.C. current with a water resistance and fuses. I am now working on a detachable part, which can be fitted over the carbons, converting it into a furnace, when necessary. An eight point needle drop annunciator shown on the wall in the centre is very useful for connection with burglar and door mat alarms, thermostats, etc.

My workshop is equipt with all the necessary wood and metal-working tools. I also have a foot-power lathe which is not shown. The chemicals of my Electro-Chemical department are kept on a shelf in my desk. I don't need a very big outfit as about all I do in this line, is to experiment with wet cells, accumulators, electro-plating, photography and occasionally I do some analysis. The upper shelf holds my library of about 30 technical books. What I value the most, tho, are my back numbers of the ELECTRICAL EXPERIMENTER, from November, 1913, to date. This indeed is a library in itself, and has been my "guiding star" since I first got to be an "Electrical Bug."—John G. Spotton, Harriston, Ontario, Canada.



Science With A Bang

By EVERSON WESTERLING


FUTURE NEWS NOT AS YET INVENTED
RADIO NEWS FROM ALL OVER THE WORLD AND ELSEWHERE
H. GERNSBACK EDITOR
H.W. SECOR ASSOCIATE EDITOR
J. KRAUS FIELD EDITOR
CONTROLLER
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CONTRIBUTING EDITORS
S. GERNSBACK
ELECTRICAL EXPERIMENTER
OLD MAN "H.G" AND HIS PERFORMING EDITORIAL WILD CATS TURNING OUT THE MONTHLY E.E. SPASM.
INSPIRED BY M. BLACK 2 D

Formula: A Ton of Brains, 20 Barrels of Ink, 2 Carloads of Paper, Hundreds of Telegrams (Radio and Cablegrams), 10,000 Letters, Photographs and Manuscripts By the Barrel, Seasoned With a Dash of Electrical and Chemical Experiments, a Wild Night Ride or Two, Via Pullman, An Airplane Trip, Etcetra, Served With a Layer of Meringue Glace (Varnished Covers) and There You Have It—Your "Electrical Experimenter."

"I JUST can't get over wondering how that New York bunch keeps on turning out this sheet month after month," Bender queried while loafing—beg pardon—leafing over the latest issue of the EXPERIMENTER.

"And," he continued, "it beats old Dutch, how Gernsback and his editorial wild cats manage to make each issue better than the one ahead of it. Where do you think that bunch gets all those ideas from anyway?"

Jazz grew contemplative as he looked wistfully over the broad expanse of the Pacific as it lapt its way toward 'Frisco Bay. He pulled a few times at his cigar before he replied with a sigh:

"Tell you the truth, gents, I'd rather live in my quiet two by four in Oakland than publish that nerve-racking, man-eating shark that goes by the name of ELECTRICAL EXPERIMENTER, better known as *Sperry* in Australia. And if Gernsback had the slightest sense of humor he'd call it ELECTRICAL *Exterminator,* because it sure will exterminate him sooner or later. No man can live and remain a human fountain of ideas day in and day out like that bird, and not dry up in the end.

"But you boys want to know how it's did every month—well, here goes, anyway:

"Last month when I went East I made it my business to call upon the E. E. outfit, and you may believe me or not, but I'm still dazed from what I saw, s'help me Caesar.

"Some fine Monday A. M. I trot down to Fulton St.—which is the dead line of the town—and pull up short at "Information," where I throw anchor.

"'Want to see the Editor. Name's Jazz Stokes from Oakland, Cal., I mentions to the cutie behind the switchboard. A couple hours later when she finally finds time to give me the once over, she smiles expensively at me and asks what in blazes I want. I repeat the info.

"'Oh, yes,' she chirps languishly, manicuring her nose with a powder-puff all the while, 'I remember you now, you are the Stoker from Coakland, Oklahoma. Excuse me for letting you wait a bit longer. Now what's your name?'

"I repeat it a few times over.

"'Age?' she asks next.

"Uncertain," I murmur.

"'Was your mother married?'

"Not yet, she's a widow!"

"'Have you ever been in jail?'

"Sure thing, that's my profession."

"'How come?'

"Well, you see, I am Warden of the jail of Berkeleigh, Cal.!"

"'That's fine. Now then on what business would you like to see the Sultan?'

"Just a friendly visit."

"Just then the house bell clanged out the noon hour, and as I had no appointment with the All-Highest, I saw it would be useless to get into his Wigwam and next to his skin. So I invited the 'Info-Switchboarder' out for lunch, as a ruse. An invitation for lunch *always* works in New York. So while she got her hat and put on her outdoor complexion, I slipt by the gate, vaulted a couple of brass railings and made a home run for the sanctum labeled 'Editor.' I pussyfooted in cautiously—which, however, wasn't at all necessary. There were three or four people in his office and no one paid the slightest attention to me, so I sat down. The illustrious 'Idea-Incubator' was very, very busy with a couple of artists, his secretary, the phone, the radiophone and his managers. During the half hour I was in that editorial bug-house, I

(*Continued on page* 1292)

THE ORACLE

The "Oracle" is for the sole benefit of all electrical experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be publisht. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addrest to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of **25 cents** is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

LAMP BULB A LEYDEN JAR.

(1039) H. Edwards, Deseronto, Ont., writes:

A. 1. While experimenting with Geissler tubes, made from burnt-out lamp bulbs as described in a former issue of your magazine, I noticed an odd thing which I cannot account for. The bulb used was an ordinary Tungsten lamp. The glass rod in the center of the bulb had been shattered in some way, so I covered the glass tip with wax and made a Geissler tube out of it. The tube was attached to a static machine capable of giving a twelve-inch spark, by a wire which was wound around the brass end of the bulb and attached to the positive terminal of the machine. A short gap was left between the two terminals of the static machine and after operating for a few minutes I pushed the terminals of the machine together and disconnected the bulb. Then I picked up the bulb without touching the brass end. When I was about fifteen feet from the static machine I happened to drop my finger onto the brass end to the bulb and drew a spark about one inch long from it. Rather surprised I carried the bulb downstairs to the science teacher of the school and showed her the spark. This time it was less strong and after two or three attempts it became totally discharged. The bulb was certainly a Leyden jar, and my hand was one coating. What had formed a second coating to hold a charge on the inside of that exhausted bulb?

A. 1. Undoubtedly you are not aware that the charge is retained in the glass, and not in the coating of the Leyden jar. The highly ionized air in the electric bulb acted as an internal coat, and induced the glass to take on the charge inside, whereas the outside coat, viz., your hand, was connected to the earth thru your body.

To prove that the charge is retained in the glass and not in the coat is very easily demonstrated in a separable Leyden jar. The Leyden jar is charged, the coats carefully removed by an insulating rod, and these, when away from the glass, may be touched with impunity. Should the fingers be placed on both sides of the glass, a slight crackling is soon heard, showing that there is some charge, which escapes very slowly. However, if the coats are now replaced and a discharger brought in contact with the inside and outside coats, a sharp crack is heard and a spark flies across the discharge ball and the knob on top, the metal coatings acting as good conductors of the charge.

MAKING PERMANENT STEEL MAGNETS.

(1040) M. F. McCormick, Crown Point, Ind., asks the "Oracle":

Q. 1. Several questions regarding permanent steel magnets; these bar magnets measuring ½x½x3 inches.

A. 1. Regarding first question, would say that a compound steel magnet made up of two separate magnets, would be approximately twice as strong as either one of the single units, as you mention; presuming that both South and both North poles are placed together, i. e., both S.S. poles at one end, and the N.N. poles at the other.

Answering your second question as to the form of magnetizing coil required, would say in the first place alternating current cannot be used, and direct current either from a lighting circuit, or else from storage or dry cells must be utilized for the purpose. A very powerful magnetizing coil may be made as follows for service in conjunction with this battery current. A brass tube, ⅝ inch inside diameter and measuring three inches in length, may be wound with 20 layers of No. 22 B. & S. gage, S.C.C. magnet wire. The magnet steel may be placed in the coil one after another and the current switched on, after each magnet is placed within the tube, the steel bars being magnetized from ¼ to ½ minute. The strongest magnetization has been found to take place in such steel bars when the current thru the coil is interrupted at short intervals. This may be done by means of a telegraph key or switch operated by hand, or else a motor or slow speed vibrating relay may be rigged up to produce this effect.

In regard to the hardening of the steel, will say you will do well to look up some good machinists' handbook on this subject, but in brief, it has been found that the steel used should preferably be a tungsten steel, and that it should be glass-hard in order to have the greatest retentivity for magnetism. It is common practice for ordinary magnets to heat the steel to a cherry red and then to plunge the bar in water; thus quenching it quickly and producing a practically glass-hard temper. We take pleasure in recommending one of the best books on magnets, i. e., the work entitled "Experiments in Electricity and Magnetism," by Sylvanus Thompson, which our "Book Department" can supply for $1.65 prepaid. A very good book covering tempering of steel, etc., is entitled "Rogers' Machinists' Guide," which can be supplied at $2.15 prepaid.

DOLLARS FOR JOKES

A SCIENTIFIC magazine is supposedly notorious for its dry reading. Still we flatter ourselves that the ELECTRICAL EXPERIMENTER can hold your attention without your yawning too frequently.

Of course you like to laugh—we all do. Sometimes we make you smile while you peruse the EXPERIMENTER. Perhaps sometimes you laugh out loud—at some of our "preposterous ideas" which we print here. And then of course the joke's on us, because we were real serious!

Now it occurred to us that we would like to print a column of real, original jokes every month, but here's the hook: The joke must be a SCIENTIFIC JOKE. No, this is no joke, we mean it!

Anyone can print or re-print jokes, but we want them with a dose of science. So, till further notice we will pay $3.00 as a monthly 1st prize for the best joke, and $1.00 for each other one we print.

So you will know what we mean with a "Scientific Joke," we print one here, which we purloined from the "Baltimore American":

LOGICAL.—"I want some good current literature."
"Here are some books on electric lighting."

Now of course, our readers can do much better than this. So let's wait and see. One reader can submit as many jokes as he pleases. Even if it is old the joke is not necessarily barred or condemned. There is one rule however: The joke must not be too technical; in other words, it must be readily understood by anyone. Not more than 100 words can be used. Use only one side of the paper.

Address
SCIENTIFIC JOKE EDITOR,
Care of this publication.

ONE OR TWO TELEPHONE RECEIVERS BEST?

(1041) A. Jarrett, New York, N. Y., inquires:

Q. 1. Which is the best, the single Bell telephone receiver or this, together with an auxiliary watch case receiver.

A. 1. With respect to the efficiency of the watch-case telephone receiver, which is commonly used and supplied by telephone companies in different cities in order to hear long distance calls more plainly, etc., would advise:

There is no doubt about it that the addition of the watch-case receiver helps very considerably. As regards the electrical efficiency, you can rest assured that there is invariably sufficient current at the telephone terminals to operate at least two receivers connected on parallel. It is the same as connecting two lamps on parallel. Twice the current is required for two telephone receivers as would be required for one, but the editor of this department has never noticed any depreciation of the speech reproduction when the multiple phone is connected, when either receiver is tested separately. Secondly the hearing efficiency is increased by this arrangement of two receivers, as has been proven in wireless work, where two receivers are always used.

In the first place, as you state, there is more sound produced, but the main and most important thing is that you in this manner bring into operation the combined hearing forces of the two ears, which co-act in a very much better manner when they are both acted upon simultaneously by the same sound, as compared to the action when one ear is affected by the sound only. Besides, as you state, there is always trouble due to external noises affecting the open or unused ear.

Radiator Cement

In liquid form and easy to use. Will ordinarily seal leaks in from two to ten minutes.

Hastee Patch

A quick, permanent, inexpensive repair for tubes and casings. Can be applied in three minutes at a cost of 2 cents.

Valve Grinding Compound

Will remove pits and foreign substances from valves, giving a velvet seat. Will not cut grooves.

Carbon Remover

An occasional dose will stop that knock—quiet the motor—and save the batteries. You can do it yourself in ten minutes.

Keep Your Car Young

It isn't fair to yourself or to your car to run it without any attention and then sell it at a big loss. With but little effort you, yourself, can keep your car in such condition that the depreciation will be very slight. We offer for your use **Johnson's Car Savers.** No experience is necessary for their use. They can all be applied by the amateur with perfect satisfaction.

Johnson's Car Savers are of the very highest quality that can be produced. You will find cheap make-shifts on the market, but when you insist upon **Johnson's** you are taking no chance, for all of our preparations are fully guaranteed.

JOHNSON'S Car Savers

Start today to reduce the depreciation of your automobile. An hour or two every month and **Johnson's Car Savers** will prove their value in dollars and cents when you come to sell or turn in your car.

Johnson's Car Savers have been on the market for several years. Millions of cans have been used by motorists everywhere with entire satisfaction.

For years our employees have been our partners and share the profits. Because of this personal interest unusual care and skill enter into the manufacture of the Johnson products—overhead is reduced to the minimum and we are enabled to sell at a very slight increase over pre-war prices, notwithstanding the tremendous advances on all of our raw materials.

Representative dealers and jobbers all over the world handle **Johnson's Car Savers.** Don't accept or handle unknown substitutes. Write for our booklet "Keep Your Car Young"—it's free.

S. C. JOHNSON & SON

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Top Dressing

Johnson's Black-Lac is the ideal top dressing. One coat imparts a rich, black surface just like new.

Auto-Lak

A splendid elastic varnish for bodies, hoods and fenders. A coat will increase the value of your car from 10% to 35%. Dries in 24 hrs.

Stop Squeak Oil

It seeps between the springs, thoroughly lubricating them. Makes your car ride easier, reduces the liability of spring breakage.

Know Your Man

—to sell to him
—to employ him
—to direct him

If you should seek for the one big qualification that has made for the success of Schwab, Carnegie, Morgan and others, you would find that they *knew men;* their ability to gather around them the right men for the right position more than any other factor contributed to their success.

Until you know how to judge men correctly, you cannot sell, direct or employ them to the full extent of your ability. You *can* know. It is easy. Mr. Wilson M. Taylor has given an infallible, correct and simple method in his new book

"The Science of Approach"

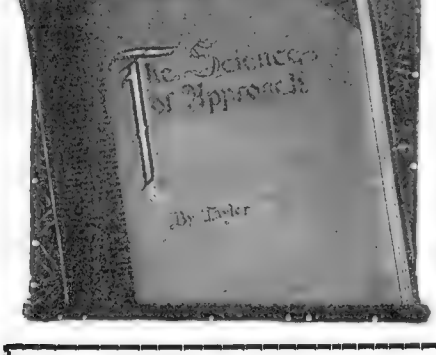
He classifies all types of men and shows you the best way to appraise quickly the minds of men of various types, to determine their inclinations, their process of thinking, their basis of judgment and decision.

Get This Key to Men's Minds

Stop guessing. Know why people like you and why they do not. Learn how to make them like you. Be able to recognize the type that thinks slowly and acts slowly, the type that thinks quickly and acts quickly, the emotional type, the mercenary type, the generous type and all other types. You can realize what an advantage this means to be able to do this. The largest firms in America are adopting Mr. Taylor's method. You, too, should have the knowledge this book contains.

Mr. Taylor Has Agreed to Send it on Five Days' Approval

Your opportunity is presented in the coupon below. Use it. All it requires is a little initiative to determine whether or not "The Science of Approach" will benefit you as greatly as it has benefited other men. You take no risk in determining this. Sign and mail the attached coupon *TODAY.*



WILSON M. TAYLOR, Inc.,
35 West 39th Street, New York City

Please send me copy of your book, "The Science of Approach," on 5 days' approval—enclosed find $2.00. If I decide not to keep the book, I will return same to you within 5 days and you are to return the $2.00, without question.

Name .....

Address ..... E. E-4-20

P.S. If you prefer, we will send book and you can send us $2.00 or return it in 5 days.

Science With A Bang

By EVERSON WESTERLING

(*Continued from page* 1289)

never got the hang of it how he made himself understood with them, or they with him. I never knew if he talked to them, to the phones, or to himself.

"Howard Brown, the gink who smears the monthly canvas cover was discussing the next spasm with the Pasha. Brown wanted to know what the main color was to be.

"'Weather Bureau,' yells the High-Chief into the phone. He gets it in a couple of seconds. 'What sort of weather will we have next month?' he bawls. 'Rain, all month, you say? O. K. Fine.'

"'The cover will be *sky blue,'* as he turns to Brown. 'As it will rain all next month, people will be tickled to see a blue sky, even if it's only on a cover. We ought to sell a couplo thousand copies on that argument alone!'

"'Fine,' says the paint cuckoo. 'Now what's the subject?'

The Grand-Duke scratches his head thoughtfoolishly while he toys with his telegraph instrument. Just then a nice ripe tomato comes sailing in thru the open window and lands squarely on the Mikado's bean. Quick like a flash he turns to Brown, and chuckling gleefully says, while blotting up the ketchup with a few blotters:

"'*That* gave me the idea. Subject will be an artificial big steel man. Show him working in a field; paint him red—like this tomato sauce. Good combination—red steel monster with a skyblue background. People will be interested in him, now that help is scarce. Open his back to show the propelling machinery inside of him—ah yes—wireless aerial on his head and in foreground radio man with a lot of wireless junk, who directs the automaton's movements in the field.'

"Fine, wonderful," we all applauded. "That's going to be *some* cover," yelped the manager. "All our competitors will die of envy, but how on earth do you get all those ideas?"

"'Simple,' chuckles the Rajah, 'the tomato gave me the idea of course! Don't you see, tomato—auTOMATOn—and where does a tomato grow? In a field! There you have it, *automaton working in field.* Next!'

Just then Secor, the associate Editor comes in with a bang thru the loud talking telephone on the wall: X ! ?!! -....---!xx Wow—R-rhrrrrrr...what in thunder do you mean by adding 8 more pages to this infernal sheet, ain't we got enough now... r-r-r--R-R-R X ! ?**——can't possibly do MORE. Killing myself now. Absolutely Impossible to do more work—I quit right here——Wah—wow—wow—whizz—bang—"and he's gone!"

"But the High-Priest thru it all keeps on smiling; it seems he likes those gentle outbursts. No sooner has the enraged editorial bird ceased fluttering than the Grand-Turk presses a button and chirps into a mouthpiece:

"'Great stuff, Secor. That talk of yours gave me a bunch of ideas to fill those eight pages: You spoke about *killing yourself;* why not send Kraus up to Sing-Sing and get some recent dope on how they electrocute the murderers up there—good for two pages with a full page washdrawing showing how it's did!

"'And you said *"What in thunder,"* didn't you, darling? Well what's the matter with making a full page drawing showing all the different stages of a thunderstorm—good for two pages.

"'Then you said *absolutely impossible,* yes, no? Well; two pages of good stuff showing historical instances how inventors made the impossible come true; ought to make fine reading—full page drawing showing those inventions, what?

"'Finally, you yelled so loud that my ears hurt. Seems as if the acoustics in my office are too good—how about two pages on acoustic freaks—echos—strange acoustic phenomena—full page illustrations how to do it—there are your 8 pages—no, don't thank me, call me up later if you need more ideas!'

"I had heard enough. I collapsed right then and there. After I came to a couple of hours later, I slunk out of this idea-monster's office. *He had never even seen me.*

After I had sufficiently recuperated I thought I'd waltz up to see this Secor bird. He looked—or rather sounded promising. As I had no appointment with the gink I bribed the elevator brigand who took me up, hidden in a big ashcan, which just went up after having emptied its load of rejected manuscripts on the paper dealer's wagon.

I was dumped onto the associate editor's floor and crept to the door labeled

HARRY WINFIELD SECOR,
E.E. I. R. E. S.O.S. P.D.Q.
ASSOCIATED EDITOR
The guy who thinks he does all the work AND DOES

Thru the door came murderous sounds, and I had already turned back on second thought, but a tall young giant who wore a sign on his hat "Field Editor" rushed up in a monstrous haste. He collided with me and we both burst thru the door into the sanctum. However, he paid not the slightest attention to me, so I sat down and looked at the scenery.

Miscellaneous, gum chewing, powder-puffing damsels sat at various desks manipulating their keys.

On the floor lay a long-haired cuckoo, "artist" painted all over him. The associate editor was just then drumming an editorial point or two into the artist's anatomy. The Grand Vizier was waving a drawing hysterically at the unfortunate rat on the floor and lambasted him for some minutes soundly.

"What in X!?X RRR do you mean by crabbing my illustration this way R!X? RRRRrrr Wow Bang Ziz.....look at this face—what will our readers think of me—I didn't want a pig's face—I want a MAN'S face—wow, bang, Rrrrrr !X..... and look at this electric current—why, it looks like a bunch of spaghetti, you fish-faced, enaemic son of a rainworm. And then look at this thing—Lord have mercy on his brain that he hasn't got. Didn't I tell you to put a derrick here—and look what this poor idiot of an evaporated mollusk-brained flea puts in its place—a HERRING, instead of a derrick. And here we're scheduled to go to press at 4:39 A. M. and the drawing must be made over again. Whizz, Bang, BANG, WOW X!?XX!?X————"

Just then the loud talker with the voice of the Editor-in-Chief's started:

"Listen Secor, I got a glorious idea, for you to work out. Best I've had since five minutes ago. Let's make a $100 prize contest what to do with discarded mouse traps. Readers like these contests—besides these popular contests bring in from 6 to 9 tons of paper which we can sell to the paper deal————"

But the voice was cut dead by a large inkstand that the irate Secor threw at the loud talker.

(*Contniued on page* 1294)

FREE Test Lesson In Draftsmanship

Send for this free lesson which explains the Chicago "Tech" method of teaching Draftsmanship by mail. Positions at big salaries are now waiting for competent men. Even draftsmen of limited training and experience are snapped up and paid good salaries. If you are dissatisfied with your opportunities, learn Draftsmanship. Chicago "Tech" will train you in the most practical way in the shortest time. Mail the coupon today and let us tell you about the Chicago "Tech" method. The free lesson will show you how well equipped you are to follow Draftsmanship. Enroll in the course only if you decide that you can take it up to advantage. No cost, no obligation on you to make this investigation. Send the coupon.

$25 to $100 a Week

Draftsmen always command good salaries. And now when American industries are to be called upon to meet vast foreign and increased domestic demands, the opportunities are greater than ever. This is the time for you to prepare for a better position—a higher salary.

Come to the College or

Learn At Home

Hold you present position while training. Our experts will instruct you by mail. Only your spare time is required. You are directly under practical draftsmen and engineers. You are taught exactly the work required in the drafting rooms of big concerns. No time put in on unnecessary studies. This means thorough instruction and early graduation.

Easy Payments

The fees for Chicago "Tech" Courses are very moderate—and you can pay on easy terms. And also, you obtain in a few months what it would take several years to acquire by ordinary methods. You can get an early start. You are soon ready to take a paying position and to quickly get back the cost of your course. Then keep on earning more.

FREE Instruments

Every student of the Chicago "Tech" mail course in Draftsmanship receives this set of instruments, or a cash credit in case he already has a set. These instruments are of the same make and sizes as are used by high salaried experts in drafting rooms of factories, shops, railroads, etc. You use them while learning—then take them right into your practical work.

Auto and Gas Engine Course

All about automobile mechanism—its construction, operation and REPAIR—taught by mail. You train directly under the Chicago "Tech" automobile experts. Splendid opportunities open now. Send coupon and get all the facts.

Learn All This in Spare Time

Principles of the Automobile. Every point made clear about the basic principles of propulsion—steam, gas and electric cars. Power transmission systems in pleasure and commercial cars, etc., etc.

Gasoline Engines. All about the different types. A complete course in gas engine construction, operation and repair.

Power Plants and Transmissions. Application of power by 4-6-8-12 cylinder engines. Types of clutches, gears, drives, axles, etc.

Carburetors and Fuel Supply Systems. All methods demonstrated. Fuel values. How to test. Gasoline and air mixtures. Regulation, care and management, etc., etc., etc.

Lubrication and Cooling. All about oils and how to test them. Splash and circulating systems. Operation in different cars explained. Diagrams and tables. Cooling systems completely illustrated, etc.

Batteries. Electrical principles explained. Instructive diagrams of wiring and connections. Coils, condensers, vibrators, etc., etc.

Magneto Ignition. Principles and practical operation of various types and systems with diagrams. Generation of current. Field, armature, high and low tension, all explained. Complete in every point.

Starting and Lighting Systems. All modern methods. Starters—spark, mechanical, air, acetylene, electric, battery—shown in detail with diagams and full explanations. Charging. Motor and generator adjustments, etc., etc.

Know How to Find and Fix Troubles

Most complete instruction in auto repair work. Equips you for high pay or to start a business. Big demand for trained repair men and men who know how to inspect cars. This course makes you proficient. Prepares you to take a job as an expert. Not enough competent men now available.

WRITE Send the coupon and get catalog and all information about the Course, the small fee and the easy terms. All this sent on request. Mail coupon now.

Send the Coupon—Now

The sooner you are prepared the sooner you will be holding a job that pays a large salary and opens the way to advancement. Many executives, general managers and superintendents began as draftsmen.

Other institutions ask you to pay first—and then to find out later how well qualified you are for this profession. We send you the free lesson first and place you under no obligation at all. Discover your qualifications before you pay anything.

The coupon will bring the Test Lesson, free. Also information about the profession of Draftsmanship and detailed facts about Chicago "Tech" methods, the fees, terms, etc. Mark with X the branch you are interested in—or if in doubt about which course to take, write a letter stating facts about yourself and asking our advice which will be freely given. Mail either the coupon or letter today.

CHICAGO TECHNICAL COLLEGE,
445 Chicago "Tech" Building, Chicago

Without obligation to me, please send me your FREE Test Lesson and other interesting literature covering the subject indicated below. Mark X opposite work in which you are especially interested.

- ☐ Architectural Drafting
- ☐ Machine Drafting
- ☐ Electrical Drafting
- ☐ Structural Drafting
- ☐ Sheet Metal Drafting
- ☐ Builders' Course
- ☐ Plan-Reading—Building
- ☐ Plan-Reading—Shop Men
- ☐ Estimating
- ☐ Surveying
- ☐ Map Drafting
- ☐ Autos and Gas Engines

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City.....State.....

College or Home Study? State which.....

Chicago Technical College 445 Chicago "Tech" Bldg. Chicago, Ill.

$1.00 Postpaid

SHAVES WITH GILLETTE BLADES

equal to any $5.00 safety razor.

Rogers Bros. new safety razor is as nearly perfect as any safety razor can be made. No expense is spared to make it the very best offer to the users of high-grade safety razors.

Note the exclusive *"Hexagon Handle"* with a *guaranteed* double silver-nickel Electroplate throughout.

Mail this Coupon Now

D. A. R. Sales Company

2521 17th Ave. So.

MINNEAPOLIS, MINN.

Enclosed find one dollar for your special safety razor offer

Name .....

Address .....

.....

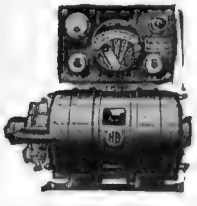
BATTERY CHARGING PAYS BIG PROFITS

$150 to $300 Profit Every Month

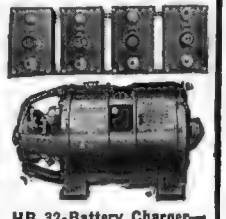
DO YOU WANT IT?

You can get it with an HB Charger. Sturdy, reliable, nothing to wear out or break. No burn-outs or expensive renewals. Charges batteries for 10c to 15c each—customer pays 75c to $1.50. Figure those profits! This season brings biggest business. Start NOW!

WHICH ONE DO YOU NEED?



HB 500-Watt Charger—Recharges 1 to 8 6-volt batteries at a time. Uses power from lines now in your garage. Should pay $100 to $200 profit a month. A big money-maker for a small battery business.



HB 32-Battery Charger—Recharges 1 to 32 6-volt batteries or equivalent at a time. Four separate charging lines, each capable of charging up to 8 batteries. Ideal equipment for big garage or battery service station. Will clear as high as $250 to $350 a month.

Sold on Trial Under HB Absolute Money-Back Guarantee. All HB Equipment is sold under our absolute guarantee of complete satisfaction. You run no risks. If not satisfied after using any HB Equipment 10 days, you may return it and receive all you paid us. The HB monthly payment plan is an additional guarantee. Write today for full information about the HB Charger that fits your battery business.

HOBART BROS. CO. **Box 48E, Troy, Ohio**

STAMPS 50 all diff. British Guiana, Cuba, China, India, Jamaica, Japan, Portugal, Venezuela, etc., only 10c; 100 all diff., 15c; 1000 all diff., fine collection in itself, $5.00; 100 diff. U. S., 30c; 1000 hinges, 10c. Agents wanted, 50% commission. List free. I BUY STAMPS.

L. B. DOVER **OVERLAND, MO.**

Science With A Bang

(*Continued from page* 1292)

"That'll keep him quiet for a while," fumed the august Vice-Chancellor. Turning to one of the female inmates of his cell at his elbow he growled:

"See, there he goes again! Ideas, IDEAS, nothing but ideas all day and night long. Any idiot can have ideas, but does he work 'em out? Not on your lip-rouge! I'm the crab that does the dirty work, and then I have to wrestle with this scum—pointing to the prostrate form of the artist—so the readers will know what it's all about. And then, five minutes before going to press that Editor-in-Cheese countermands the order and sings out that he thinks a contest of discarded straw-hats would be preferable to old mouse traps——"

Just then there was a comparative lull while His Majesty came to blows with the Field Editor, because the latter hadn't fielded about something or other.

I took the occasion to approach the Lady in Waiting to his Highness.

"Enchanted inmate," I ventured, "could I speak for a few seconds with the Chief of the Harem? Name's Jazz Stokes from California. Tell the Señor I am here to talk on business, but if Monseigneur is too busy, I will wait awhile."

The Lady in Waiting gave no sign of approval, either negative or positive, so I took the occasion and made good my threat. I waited. I got even, however, because I pulled out my stopwatch and timed her gum chewing. She batted a high average. As a matter of fact she could chew faster than the rest of the ward inmates.

Just then a herd of draftsmen, photo engravers, boys with printer's proofs, professors with manuscripts in one hand and bills in the other, descended upon the unfortunate Secretary of Labor. He singled out one of the draftsmen who was twenty-four hours overdue with his drawings, and threw a bulky "Encyclopedia Germanica" at him. It caught the victim amidships, and as I stood behind *him*, he caught *me* well on my starboard side. We both had a pleasant sail thru the door and before landing, the draftsman introduced himself. "That's the second time he threw me out this week, but I don't mind it. *I* carry accident insurance—and he needs the exercise, poor boy——"

On my way down I stopt at a door labeled

S. GERNSBACK
CIRCULATION DEPT.
WRINKLES & FORMULAS

On entering softly I found this worthy flanked on all sides by many female assistants and keybangers all equipt with gas-masks. Unlike the other offices, a supreme quiet reigned here. It took me some minutes before I could make out the form of the Captain of the ship. Clad in an acid-stained duster, he was sitting behind a curious desk arrayed with every conceivable piece of junk, chemical glassware, magazines, bottles, shower bath, miscellaneous cats, minerals, one or two gross variegated ash trays, each with a legend: *No smoking;* files—letters, mail and cross cut—books, books, books, manicure set, test tubes, goggles, gold fish, auto tire, and too many other items impossible to encompass into the four ends of a compass.

The air reeked of the smell of putrefied codfish, but changed to the perfume of a dying rose the next, only to be transformed into the odor of fragrant frankfurters a second after. I then understood the gas-masks of his victims sitting about the office.

Just then by means of a dozen retorts and test tubes he composed an odor sonata in B-sharp. I felt myself transported from the perfume of a vamp's boudoir, to the Chicago stock yards, thence to a sweet jasmine and rose field, only to be hurled immediately into the agonizing stench of a glue factory.

Before I had recovered there was a slight explosion of one of the formulas, and a large brick came sailing my way. It knocked me down flat, but the odor liberated by the explosion soon revived me. Coughing, puffing and sneezing, I galloped down the stairs forgetting entirely to introduce myself to the Wrinkle Professor. I went down six flights of stairs and cast anchor on a door mat resting before a door neatly smeared:

ROBERT W. DEMOTT
(accent on the Dee)
Advertising, etc.

This office was mostly desks. A whole forest of them. The inmates of the dormitory when they wanted to cross from one state to the other used an overhead trolley and a rope about the neck. This was by far the most elaborate Harem of the whole joint. The types varied from the opulent oriental to the Indian version of a Totem Pole. Being in the advertising office, they believed in advertising: bare arms, bare backs, and neat ankles were well advertised. By their flashing white teeth you saw at once that they were using a widely advertised brand of toothpowder. They all wore expensive smiles of the well-known and advertised brand: "The smile that won't come off."

The Chief was doing an elaborate War Dance, accompanied by the tam-tams of the typewriter keys.

Thomas A. Edison and Nikola Tesla, who had a story running in the next issue begged humbly to be allowed to have their articles run "next to pure advertising." Edison wanted to have most of his story sandwiched in between Correspondence Schools and Patents because he was cuckoo on them, while Tesla, having more aesthetic inclinations, wanted his story to run alongside the Wireless Ads and the High Frequency Machine Ads. These being his inventions, he thought it was no more than right that his story should be well garnished with them.

But the Chief of the Tribe was obdurate. He wouldn't listen. He said the other writers must have a show, too, and so on and so forth. Finally Edison hit upon a fine idea. *He would pay for the space alongside the ads* and run his story in that space. Before the Advertising Admiral had recovered from his surprise, both Edison and Tesla had planked down a thousand dollars on his desk and flown the coop.

The only comment the General made was: "Chump that I was. If I had only thot of it myself, I could have played those birds against each other and gotten double the rates!"

Just then six or seven trembling men stalked in. I soon saw that they were big advertisers of the magazine. Their contracts had run out at 6 A. M. that morning, having been in force for four long days. By that time a new rate had gone into effect which threatened to ruin them. Would the Secretary of State not allow them to let the old contract run for two more days? Or if not, would he not be satisfied with a raise of 450%.

The Sheik pondered for a long time. Then he called over one of his Phoebe Snow's and asked for the latest time table, better known as *rate card.*

(*Continued on page* 1298)

Revitalize Your Tired Nerves!

Vitality

The Violet Rays send a spray of mild, tiny currents through every part and organ, vitalizing and invigorating every cell. It acts like the refreshing effects of a shower bath—and leaves you with a delightful feeling of bounding health and bouyant energy.

Beauty

Violet Rays purify the scalp and stimulate hair growth—a wonderful aid to beauty. Removes eczema, pimples, blackheads, obesity—giving the skin a smooth fine texture, free from blemishes and sallowness.

Magic-Like Treatment For:

This is only a partial list of the many ailments that can be treated successfully with Violet Rays right in your own home.

Asthma	Goitre
Barbers' Itch	Insomnia
Boils	Lumbago
Blackheads	Nervousness
Bunions	Neuralgia
Callous	Neuritis
Catarrh	Obesity
Chilblains	Pains
Colds	Paralysis
Corns	Piles
Constipation	Pimples
Dandruff	Pyorrhea
Deafness	Rheumatism
Earache	Skin Diseases
Eczema	Sore Throat
Eye Disease	Sprains
Falling Hair	Tonsilitis
Hay Fever	Whooping
Headache	Cough

Simple, Delightful Treatments Right In Your Own Home

Enjoy wonderful, sparkling health! Feel the thrill of the bounding vitality of youth! Increase your store of energy, revitalize your worn out cells, make every fibre of your body tingle with a new vim and vigor! All this you can have through the magic of Vi-Rex Violet Rays right in your own home!

Violet Rays penetrate to every cell in the body, imparting that stimulating vigor which brings the glow of health, tones up the entire system, putting life into over-taxed and sluggish tissues. As a quick relief from pain Vi-Rex has no equal. Its soothing rays quickly find the source of distress and afford speedy comfort. Headaches, nervousness, skin blemishes and many other complaints vanish as if by magic through this marvelous treatment. You will be amazed at the splendid, quick results through the use of this wonderful new Vi-Rex Violet Ray Machine—right in your own home!

VIOLET RAYS

The Amazing New Source of Health, Energy and Beauty

Vi-Rex Violet Rays are effective for a host of disorders and ailments. Physicians in all parts of the country are adding this scientific outfit to their equipment and recommending its use to their patients. Beauty specialists have long realized its efficiency for inducing a clear and healthful skin. Until recently expense prohibited the use of this remarkable health-building force in private homes. Now the practical, inexpensive Vi-Rex Violet Ray Machine enables everyone to enjoy all the benefits of this marvelous treatment at home.

The operation of the outfit is simplicity itself. Current from your electric light socket is transformed into an effective healing agent as pleasant to the senses as a ray of spring sunshine. It may be used on the very young and the very old without the slightest discomfort. No shocks or jolts—just a soft steady ray of violet light filled with an abundance of health and energy. (Special equipment is supplied to you at a trifling cost if electric current is not available.)

20 Home Self-Treatments FREE

You don't have to take any risk in giving Vi-Rex Violet Rays a trial. Take 20 treatments in your own home. Use this marvelous machine morning and night for ten days. If you do not find quick relief—if you do not feel better, sleep better, *look* better, send it back and you will not be out one penny. This special offer is now open but it may be withdrawn at any time so act quickly!

Not a Viabrator

The Vi-Rex Violet Ray Machine is not a vibrator—does not shock or jar the nerve ends. Its effectiveness is obtained through its power of penetration—not through manipulation of surface muscles. No feeling of soreness or exhaustion after use—only a comforting, agreeable sense of relief.

Write for Free Book and Trail Offer

Write to-day for our free booklet describing the wonderful Vi-Rex outfit in complete detail, and particulars of our liberal 10-day trial offer. Find out how Violet Rays will help you. Read what hundreds of users say about the Vi-Rex and astonishing results which have been obtained. Learn why it is the most economical and practical machine of its kind available. You may use it to gain health, vitality, beauty! There is no limit to its beneficial powers. Mail the Coupon or send a postal. Do it now.

Vi-Rex Electric Co., Dept. 44
326 W. Madison St., Chicago

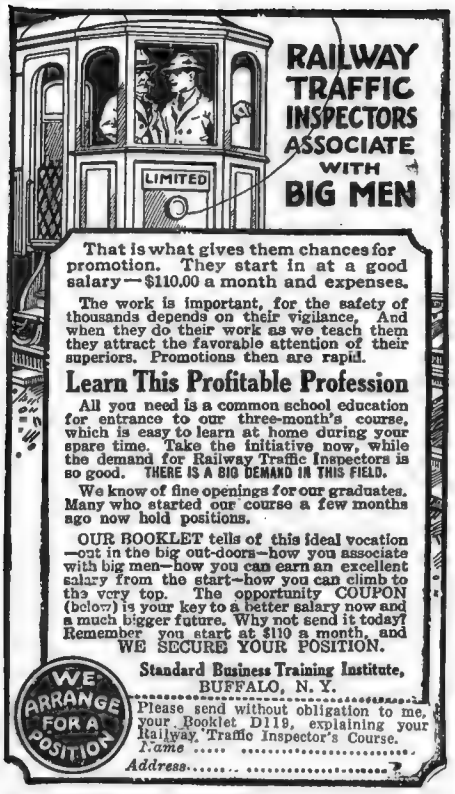
Vi-Rex Electric Co.,
Dept. 44
326 W. Madison St., Chicago

Please send me without cost or obligation your free book describing your wonderful Violet Ray Machine.

Name.....

Address.....

City.....State.....



RAILWAY TRAFFIC INSPECTORS ASSOCIATE WITH BIG MEN

That is what gives them chances for promotion. They start in at a good salary—$110.00 a month and expenses.

The work is important, for the safety of thousands depends on their vigilance. And when they do their work as we teach them they attract the favorable attention of their superiors. Promotions then are rapid.

Learn This Profitable Profession

All you need is a common school education for entrance to our three-month's course, which is easy to learn at home during your spare time. Take the initiative now, while the demand for Railway Traffic Inspectors is so good. THERE IS A BIG DEMAND IN THIS FIELD.

We know of fine openings for our graduates. Many who started our course a few months ago now hold positions.

OUR BOOKLET tells of this ideal vocation—out in the big out-doors—how you associate with big men—how you can earn an excellent salary from the start—how you can climb to the very top. The opportunity COUPON (below) is your key to a better salary now and a much bigger future. Why not send it today? Remember you start at $110 a month, and WE SECURE YOUR POSITION.

Standard Business Training Institute, BUFFALO, N. Y.

WE ARRANGE FOR A POSITION

Please send without obligation to me, your Booklet D119, explaining your Railway Traffic Inspector's Course.

Name .....

Address .....

MARKO
STORAGE BATTERIES
ARE GOOD—TRY ONE
Paul M. Marko & Co., Inc.
1402-1412 Atlantic Ave.
Brooklyn, N. Y.

ARE YOU BASHFUL, TIMID

Self Conscious, Embarrassed in Company. Let us tell you how you can overcome these troubles and acquire Poise, confidence, assurance and a magnetic personality. Address The Veritas Science Institute, 1400 Broadway, New York, Desk 15.

Printing Cheap

Cards, circulars, labels, book, paper. Press $8. Larger $25 Job press $100. Save money. Print for others, big profit. All easy, rules sent. Write factory for press catalog, TYPE, cards, etc. THE PRESS CO., D-47, Meriden, Conn.

Advertising Talks

NUMBER 6

AN OPEN LETTER TO MR. THOMAS REED.

Dear Mr. Reed:—

A long time ago you wrote me this letter. I'll reproduce it here because it's so long ago you probably have forgotten it.

Mr. R. W. DeMott,
Advertising Manager,
The Electrical Experimenter,
New York City.

Dear Sir:—

I was interested in your address to the readers in this month's Experimenter, and will bring to your attention a little suggestion which I think you may be glad to have.

You will understand that the incident related in the enclosed letters was to me nothing more than an annoyance, but if the practice is a general one of this advertiser, it must be causing real disappointment among our readers, most of whom are boys with little money to spend. My suggestion is that you require all advertisers to state that their merchandise is "postage free" or else give the weight or something to indicate that postage is extra.

In the case referred to I assumed that the price of 50c on these ringers included postage. The advertiser sent me the ringers charging me the 30c postage as an extra to be collected C. O. D. As the cost of the merchandise was only $1.00, the 30c extra charge was quite annoying. It also gives this advertiser an unfair advantage, because his prices look lower than they really are.

I have no doubt that the advertiser omitted the postage information thru oversight, but I don't want our boys to feel "stung" in the slightest degree when they answer our ads, which are not the least interesting part of the magazine. There is a chummy atmosphere about "E.E." which extends to the ads to quite a degree and which I should think the advertisers would find it to their interest to cultivate.

Very truly yours,
(Signed) Thomas Reed.

Now, Mr. Reed, I want to apologize first off for not having answered sooner. The point you bring up is so important to our readers that I thought the best way of answering your letter would be thru this column. But there has been such a rush of other news these past few months—so many items of big interest to our readers—that my little sermons temporarily "got the gate". (Bet you never even noticed that they weren't in.) And so your letter remained filed away in a special folder and, frankly, it slipt my mind.

It wasn't until Friend Secor, Boss of the Ink Slingers from the Editorial Department, just because he happened to be in Cincinnati, 750 miles from home, with a hole in the magazine, and no news to fill it, stuck No. 5 of my little talks in the November issue. But lots of other things just as bad happened to that issue—that one we printed out in Cincinnati while the printers were on strike in New York.

Anyhow it did one good thing—it reminded me that I had a letter to answer. So I got busy and by exerting every pull I could spring got the loan of part of two columns in this issue.

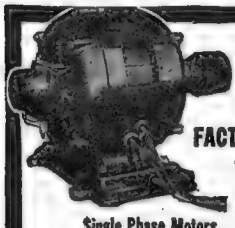
Mr. Reed, your point is well taken from one standpoint. But here's the big rub in the mail order field. Suppose you buy some goods from New York. You live in Boston. Parcel Post rates are cheap between these points. Now suppose someone else living in San Francisco buys the same article. Do you want to pay part of his parcel post or express charges? That is what it would amount to if transportation charges were included in the price. The manufacturer or seller would have to add an item for shipping that would constitute the average shipping cost for all his sales. That means that the man nearest his plant would pay part of the shipping expense of the man far away and the one at a great distance would get his goods more cheaply than he should.

For this reason it is customary in the mail order field to quote prices net (without transportation charges).

And so it has become a recognized fact that most mail order concerns require the shipping charges added to the cost of the goods or else they ship "charges collect." It is pretty safe to assume that unless the price of an article is marked postpaid the price does not include the transportation charges.

It seems to me that it is more my duty to explain this to our readers rather than to try to change the advertisers' policy. Don't you agree? We certainly don't want any reader to feel "stung" when he buys from an advertiser and it is my aim to keep

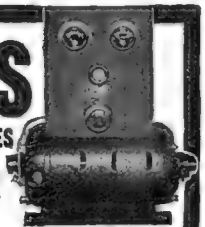
(*Continued on page* 1326)



NEW MOTORS

FACTORY GUARANTEED • ALL SIZES • IN ORIGINAL BOXES

Your Opportunity To Buy New Guaranteed Electrical Apparatus of Standard Manufacture.



Single Phase Motors
110-220 volts, A. C., 60 cycle, 1800 R. P. M. with pulley

1/4 H. P., 110 volts, induction, full load start - - $24.50
1/2 H. P., 110-220 volts, induction, full load start - $38.50
1/2 H. P., 110-220 volts, repulsion, for compressor $46.50
1 H. P., 110-220 volts, repulsion, with sliding base - - $67.50
2 H. P., 110-220 volts, repulsion, sliding base $108.50
3 H. P., 110-220 volts, repulsion, sliding base $124.50
5 H. P., 110-220 volts, repulsion, sliding base $164.50

Charging Generators
Suitable for all lighting Battery Charging and Power Requirements.

6 volts, 10 amp. $16.50
15 volts, 10 amp. $21.00
48 volts, 6 amp. $24.50
110 v, 2½ amp. $24.50
48 volts, 12 amp. $38.50
110 volts, 5 amp. $38.50
48 volts, 25 amp. $58.50
110 volts, 10 amp. $58.50
Moving Picture Arc Generator $85.00

Polyphase Motors
2 and 3 phase, A.C., 220 v, 60 c, 1750 RPM., complete with base and pulley.

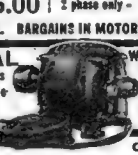
½ H. P. - $42.50
1 H. P. - $59.50
2 H. P. - $72.50
3 H. P. - $84.50
5 H. P. - $102.50
1 H. P., high speed, 3600 R.P.M., 220 v 2 phase only - $36.50

Battery Charging Outfits
To operate on A. C., 60 cycle, single phase voltage as specified.

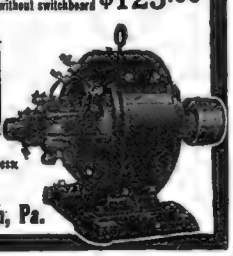
110 volts, A. C., 100 watt, 24 volts, without switchboard $40.00
110 volts, A.C., 150 watts, 30 volts, with switchboard $68.50
110-220 volts, A. C., 250 watts, 24 volts, without switchboard - $75.00
220 volts, A.C., 300 watts, 30 volts, without switchboard - $85.00
110 volts, A.C., 375 watts, 30 volts, without switchboard - $85.00
220 volts, A.C., 500 watts, 48 volts, with switchboard $110.00
110 volts, A.C., 750 watts, 72 volts, without switchboard $125.00

WRITE FOR CATALOG. BARGAINS IN MOTORS AND GENERATORS

SPECIAL 1/4 H.P. 110 volts A.C., 60 c S.P., 1750 RPM. Complete, cord, plug & pulley



WASHING MACHINE MOTORS Suitable for operating Small Compressors, Coffee Grinders, Bottle Washers, Etc. $19.75 EACH Reg. Value $22.50



MONEY BACK GUARANTEE

SHIPPING TERMS: 25% deposit required on all orders. Balance C. O. D. by Express Sight draft with Bill of Lading attached by freight.

MANUFACTURERS' DISTRIBUTER
CHAS. H. JOHNSTON, Box 32 West End, Pittsburgh, Pa.

Sole English Agents for

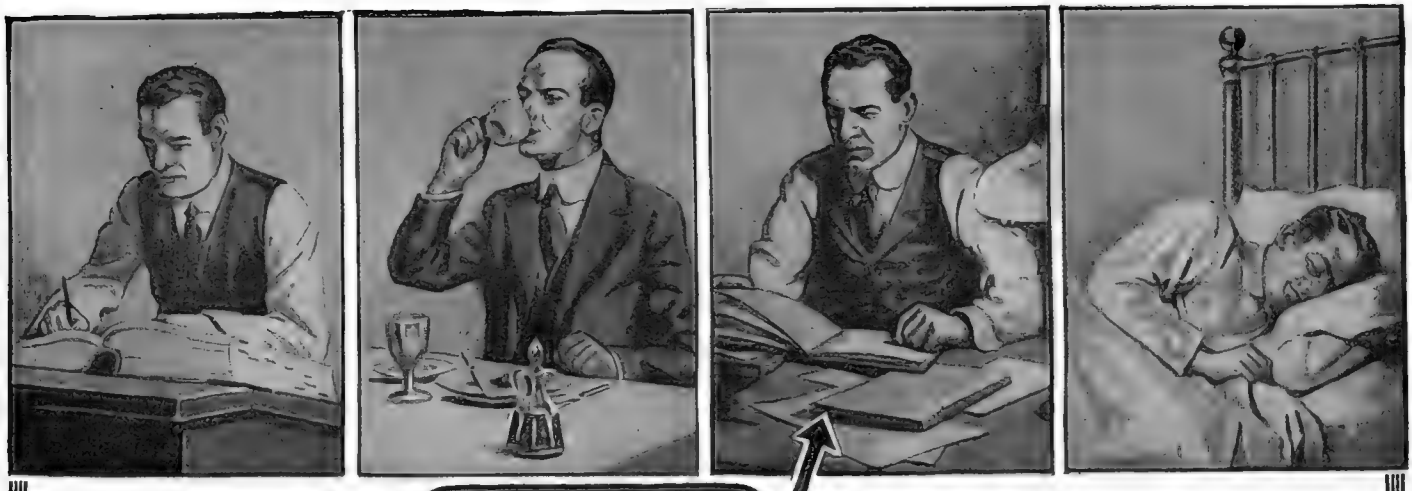
ELECTRICAL EXPERIMENTER
SCIENCE AND INVENTION

We are sole distributors for the ELECTRICAL EXPERIMENTER in Great Britain. If you reside anywhere in England, communicate with us and we will see that you are supplied each month.

1/6 the Issue

Specimen Copy sent post free upon receipt of a postal order or stamps for 6d. Address Dept. 7.

Messrs. Geoffrey Parker & Gregg
62, The Mall
Ealing. London, W. 5



These Are The Hours That Count

MOST of your time is mortgaged to work, meals and sleep. But the hours after supper are *yours*, and your whole future depends on how you spend them. You can fritter them away on profitless pleasure, or you can make those hours bring you position, money, power, *real success* in life. Thousands of splendid, good-paying positions are waiting in every field of work for men *trained to fill them.* There is a big job waiting for *you*—in your present work or any line you choose. Get ready for it! You can do it without losing a minute from work or a wink of sleep, without hurrying a single meal, and with plenty of time left for recreation. You can do it in one hour after supper each night, right at home, through the International Correspondence Schools.

Yes—You Can Win Success in an Hour a Day

Hundreds of thousands have proved it. The designer of the Packard "Twin Six," and hundreds of other Engineers, climbed to success through I.C.S. help. The builder of the great Equitable Building, and hundreds of Architects and Contractors, won their way to the top through I.C.S. spare-time study. Many of this country's foremost Advertising and Sales Managers prepared for their present positions in spare hours under I.C.S. instruction.

For 28 years men in offices, stores, shops, factories, mines, railroads—in every line of technical and commercial work—have been winning promotion and increased salaries through the I.C.S. Over 100,000 men are getting ready *right now* in the I.C.S. way for the bigger jobs ahead.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6226, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ADVERTISING	☐ ELECTRICAL ENGINEER	☐ MECHANICAL ENGINEER
☐ SALESMANSHIP	☐ Electrician	☐ Mechanical Draftsman
☐ Traffic Management	☐ Electric Wiring	☐ Machine Designer
☐ BUSINESS MANAGEMENT	☐ Electric Lighting	☐ achine Shop Practice
☐ Private Secretary	☐ Electric Car Running	☐ Boilermaker or Designer
☐ Commercial Law	☐ Heavy Electric Traction	☐ Patternmaker
☐ Certified Public Accountant	☐ Electrical Draftsman	☐ Toolmaker
☐ Higher Accounting	☐ Electric Machine Designer	☐ Foundry Work
☐ Railway Accountant	☐ Telegraph Engineer	☐ Blacksmith
☐ BOOKKEEPER	☐ Telephone Work	☐ Sheet Metal Worker
☐ Stenographer and Typist	☐ ARCHITECT	☐ STEAM ENGINEER
☐ Good English	☐ Architectural Draftsman	☐ Stationary Fireman
☐ Window Trimmer	☐ Contractor and Builder	☐ MARINE ENGINEER
☐ Show-Card Writer	☐ Building Foreman	☐ GAS ENGINE OPERATING
☐ Sign Painter	☐ Carpenter	☐ Refrigeration Engineer
☐ CIVIL SERVICE	☐ Concrete Builder	☐ Metallurgist or Prospector
☐ Railway Mail Clerk	☐ PLUMBER & STEAM FITTER	☐ CIVIL ENGINEER
☐ Mail Carrier	☐ Heating & Ventilation	☐ Surveying and Mapping
☐ CARTOONIST	☐ Plumbing Inspector	☐ R. R. Constructing
☐ Illustrator	☐ Foreman Plumber	☐ Bridge Engineer
☐ Perspective Drawing	☐ CHEMIST	☐ SHIP DRAFTSMAN
☐ Carpet Designer	☐ Analytical Chemist	☐ Structural Draftsman
☐ Wallpaper Designer	☐ Locomotive Engineer	☐ Structural Engineer
☐ Bookcover Designer	☐ Roundhouse Foreman	☐ Municipal Engineer
☐ TEACHER	☐ MINE FOREMAN OR ENGINEER	☐ NAVIGATION
☐ Common School Subjects	☐ Coal Mining	☐ Motor Boat Runn'g ☐ Spanish ☐ French
☐ High School Subjects	☐ Metal Mining	☐ AGRICULTURE ☐ Italian
☐ Mathematics	☐ Assayer	☐ Fruit Growing
☐ AUTOMOBILE OPERATING	☐ TEXTILE OVERSEER OR SUPT.	☐ Vegetable Growing
☐ Automobile Repairing	☐ Cotton Manufacturing	☐ Live Stock & Dairying
☐ Auto. Electrical Work	☐ Woolen Manufacturing	☐ POULTRY RAISER

Name_____

Occupation and Employer_____ 7-26-19

Street and No._____

City_____ State_____

Your Chance Is Here!

No matter where you live, the I.C.S. will come to *you*. No matter what your handicaps, or how small your means, we have a plan to meet your circumstances. No matter how limited your previous education, the simply written, wonderfully illustrated I.C.S. textbooks make it easy to learn. No matter what career you may choose, some one of the 280 I.C.S. Courses will surely suit your needs.

Make Your Start Now!

When everything has been made easy for you—when one hour a day spent with the I.C.S. in the quiet of your own home will bring you a bigger income, more comforts, more pleasures, all that success means, can you afford to let another single priceless hour of spare time go to waste? Make your start right now! This is all we ask: Without cost, without obligating yourself in any way, put it up to us to prove how we can help you.

Just Mark and Mail This Coupon

BE AN ARTIST

DRAWN BY 14-YEAR-OLD BOY

The above cartoon was drawn by Master Bob Brennan of the Washington School of Art. Bob writes that he is selling his work and that he is cartoonist on a small paper in Evansville, Ind. He is but one of our many students and graduates who are making money as cartoonists, illustrators and designers.

Learn By Mail at Home!

By our new method of teaching drawing by mail you can learn in your own home, in a short time. Get into this fascinating work yourself and earn $50 to $100 or more per week! The study is fascinating. Only a few minutes a day! Have your own studio or secure high-salaried position. Or work in spare time. Many students earn while they are learning.

FREE! BOOK AND ARTISTS' OUTFIT! WRITE TODAY

A complete outfit *free* to all students. Includes everything required to produce hundreds of dollars' worth of pictures. Write today. Special terms to a limited number of new students. Mail postal or letter for beautiful Booklet, "How to Become an Artist," filled with drawings and full particulars of our extraordinary offer. Do it now—Before you forget.

WASHINGTON SCHOOL OF ART, Inc.
1488, H Street, N. W. Washington, D. C.

"Old Town Canoes"

An "Old Town Canoe" will jump at the thrust, or glide at the dip of a paddle. Floats light as a fleck of foam, but every "Old Town" has the built-in strength and sturdiness to withstand many years of rugged service. For the youngsters, buy the "Sponson Model" the canoe that's safer than a row boat. Write for catalog. 3000 canoes in stock. $67 up from dealer or factory.

OLD TOWN CANOE COMPANY
954 Fourth Street
Old Town, Maine, U.S.A.

FREE Puncture Proof Tube

18,000 Miles Record of this Tube.

A puncture proof tube FREE with every Public Tire ordered. Public Tires are reconstructed and guaranteed on 6,000 mile basis.

Price Includes Tubes and Tires

28x3	$ 6.80	34x4	$11.30
30x3	7.20	34x4½	12.95
30x3½	8.30	35x4½	13.20
32x3½	8.90	36x4½	13.70
31x4	10.15	35x5	14.35
32x4	10.50	36x5	14.70
33x4	10.95	37x5	14.95

In ordering state whether SS or CL is desired. Send $2.00 deposit for each tire. Bal. C. O. D. subject to examination. 5% special discount if full amount sent with order.

We send you our guarantee bond with order. This is your protection.

PUBLIC TIRE CORPORATION
Dept. 54 3500 S. Michigan Ave., Chicago, Ill.

Science With a Bang

(*Continued from page* 1294)

"When did this rate go into effect?" he queried.

"Ten A. M. this morning," she sang out in "His Master's Voice." "But," she added, "there's a new rate going into effect at 3:51 P. M. this afternoon. The gentlemen are just in time to catch it, the ten o'clock one being obsolete by this time."

"Have you figured out the 3:51 P. M. rate yet?"

"No, not yet," she coughed nervously over a "Smith Brothers' Cough-drop."

"Alrite, I do it myself," gravely spoke the Maharajah. "And to show you that our advertising rate is absolutely legitimate I will place my (rate) cards upon the table and show you the scientific manner by which we dope out our rate."

"By referring to 'Bradstreet's index' you will find that the price of paper has gone up, 22% since last night. Printing went up 26%. Ink 14%. Face powder 29%—my squaws here use it, hence it must go into the rate card. Rent's gone up 110%. Chewing gum 11%—used by our amazons for efficiency. Salaries increased 14%. Typewriter ribbon 16%. Cost of printing rate cards went up 84%. Dog biscuits 21%—this item too goes into the rate card because I own a watch dog. Fountain pen ink increased 15%. Desk blotters 5%. Bill heads—to send you your bills 22%. To this I must add an increase of 100% to my family—had twins last night, you see. Adding up these figures gives a grand total of 489%. The last rate being $300 a page, that makes this evening's rate $1,467 per page.

"Please sign on the dotted line. You'll excuse me while I catch my train, must see how the twins are getting along——"

"Well, boys, they had to carry me out on a stretcher," concluded Jazz, "and you may believe it or not, but I hadn't shook hands or spoken to anyone of that tribe of wild cats."

"Well," said Bender, "as far as I can see, you didn't miss much."

Telegraph, Cable and Radio Dispatches

By PIERRE H. BOUCHERON, Ensign U. S. N. R. F.

(*Continued from page* 1259)

letters in length they are not accepted by cable or radio companies at code rate, but must be counted and charged for at cipher rate; that is, five letters to the word.

Cipher language is a group arrangement of disconnected letters or numerals having a secret meaning known only to the sender and receiver. It is accepted by telegraph, cable or radio companies when a message is made up of unintelligible and unpronounceable groups of letters or figures representing words and is counted and charged for at the rate of five letters or figures to the word. When letters and figures are mixed in one word, however, each individual letter or figure is counted separately. The following are examples of how such cipher is counted:

CZOTN—1 word.
TRNSIM—2 words.
73570—1 word.
C51N7—5 words.

Exceptions: Words which are not considered as having a secret meaning, such as the trade-marks COF59, IP76 and the commercial expressions COD, OK, FOB, CIF, AM, PM, USS, RR, SS, etc., are counted and charged for at the rate of five letters to the group or word.

Miscellaneous: Recognized names of foreign countries, states, provinces, cities, vessels, etc., are counted and charged for as

(*Continued on page* 1300)

Sharp Turn!

It's easy for this fellow. Steering 'round corners and out of tight places is a feature of the Auto-Wheel Coaster and Auto-Wheel Convertible Roadster. These wagons develop the best motorists—with sharp eyes and keen nerves.

Roller-Bearings, cut-under wheels, wide-sweeping steering-tongue. Built durably to give years of service. The Auto-Wheel will carry a 1,000 lb. load.

Two types: Auto-Wheel Coaster—for all 'round coasting and hauling. Auto-Wheel Convertible Roadster—two wagons in one, changed from box wagon to speedster in half a minute.

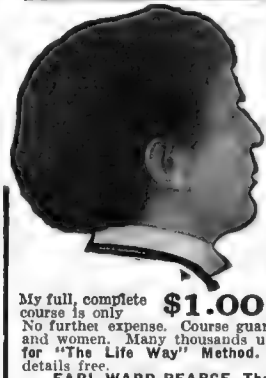
Felt Pennant Free

Also descriptive booklet, and our new magazine for boys—for the names of three local coaster dealers. Mention which one handles the wagon with Auto-Wheel Coaster or Auto-Wheel Convertible Roadster on the sides.

Organize an Auto-Wheel Coaster Club. Free caps to members. Special cap to Captain. Get busy.

The Buffalo Sled Company
163 Schenck St., N. Tonawanda, N.Y.
In Canada: Preston, Ont.

Luxuriant Hair



DON'T dye old hair, but grow new hair, of normal color—using "The Life Way" Method for eradicating baldness, falling hair, dandruff and other ills.

By my method you Awaken, Vitalize and Energize the Scalp—making and keeping it Soft, Cool, Flexible and Fertile—feeding, lubricating and cultivating the hair—toning up the pigment glands and coloring it from within.

I do not use any tonics, dyes, apparatus or drugs.

My full, complete course is only **$1.00** No further expense. Course guaranteed. For both men and women. Many thousands using it. **Send a dollar for "The Life Way" Method.** Reports and further details free.

EARL WARD PEARCE, The Life Way Studios
Dept. 58, Los Angeles, U. S. A.

ONE PIECE

On market 5 years. 1,000,000 a month. Beware imitations. "NO-LEAK-O" Patented.

NO-LEAK-O PISTON RING CO., BALTIMORE, MD.

WIRELESS

Our big, new electrical cyclopedia No. 22 is waiting for you. Positively the most complete Wireless and electrical catalog in print today. 80 Big Pages. 150 illustrations. 200 instruments and apparatus, etc. Big **"Treatise on Wireless Telegraphy,"** 20 FREE coupons for our 160-page FREE Wireless Course. FREE Cyclopedia No. 22 measures 6 x 9. Beautiful stiff covers. Sent for 6 cents in stamps or coin.

ELECTRO IMPORTING CO., 231 Fulton St., N. Y.

14 x 17 OIL PAINTED ENLARGEMENT FROM

any film or photo. Send $3.00. Give color eyes, hair, etc. Equals $25 work. Reference—Any Bank.

TANGLEY CO. DEPT. E4, MUSCATINE, IOWA

Don't Waste Time

Learn Electricity —the New Way

IT'S no longer necessary to go to school or serve an apprenticeship to learn electricity. With this new library of APPLIED PRACTICAL ELECTRICITY you learn right at home—in your spare time without interfering with your present work.

Any big job that you want in the electrical field is yours if you will train yourself to fill it. It only takes an hour or two a day with these books.

This is the 1920 edition—new from cover to cover—chuck full of the latest methods and most recent discoveries in this fascinating field. Everything is written in plain, good old U. S. language by 27 of the greatest experts in the business. The eight volumes with 3800 pages make up a complete course in electrical engineering. It's a home study course for the beginner and a handy reference guide for the expert combined.

Big Pay for Trained Men Jobs paying $1500.00 to $5000.00 a year are waiting for men who can qualify as Electrical Engineers—Substation Operators—Troublemen—Switchboard Operators—Dynamo Tenders—Electricians. Electricity is the greatest force in the world and it is growing bigger and bigger every day. More and more men are needed all the time. Why don't you get into this big paying field now?

Good Jobs Are Waiting If you are trained in some branch of electricity you will never have to look for a job. The job and the big pay will be looking for you. You can't dodge a good job if you have the "know how" under your hat. Let these 27 great engineers help you to the best kind of job with their books.

Send the coupon below and get them for FREE examination. See our free offer below.

What the Books Teach Elements of Electricity—Electrical Measurements—Electric Wiring—Underwriter's Electrical Requirements—Theory, Calculation, Design and Construction of Direct Current Generators and Motors—Types of Generators and Motors—Management of Electrical Machinery—Electric Lighting—Alternating Current Machinery—Power Transmission—Electric Railways—Self-Propelled Railway Cars—Trackless Trolley—Power Stations—Switchboards and Switching—Storage Batteries—Applied Electro-chemistry—Electric Elevators—Electric Welding and Heating—Wireless Telegraphy and Telephony—Land and Submarine Telegraphy.

Free Service With every set of these great electrical books we give a one year membership in this society. This entitles you to consult our engineers and experts on any electrical problem. Write as often as you like. Ask as many question as you like for one year.

The World's Greatest Electrical Books LOANED to YOU FREE

We will lend you this wonderful library to use in your own home or shop a whole week FREE. It won't cost you one cent. DON'T SEND ANY MONEY. Just fill out and mail the coupon today and the set of eight volumes will come to you by express collect. You be the judge and find out for yourself what the books will do for you. Use them as you please. Show them to your friends and get their opinion. Then if you have any doubt as to their value send them back at our expense and you won't owe us anything.

Only 7 Cents a Day

If you like the books after a week's examination you pay us only $2.80 and $2.00 each month until $29.80 is paid. This is only 50 cents a week—7 cents a day. You can't afford to pass up a better job on these easy terms. MAIL THE COUPON NOW.

American Technical Society
Dept. E 254, CHICAGO

Coupon is All You Need— Send it Now

American Technical Society
Dept. E 254
Chicago, U. S. A.

Please send me the 8-volume set of Electrical Engineering for 7 days' examination, shipping charges collect. If I decide to buy I will send $2.80 within 7 days and balance at the rate of $2.00 a month until $29.80 has been paid. Then you will send me a receipt showing that the set of books and the Consulting Membership are mine and fully paid for. If I want to get along without the books, I will return them, after 7 days, at your expense.

Name.....

Address.....

Reference.....

Be a Draftsman!

Make $30 to $75 a Week

Your name and address on the coupon brings this great Cyclopedia of Drawing without a penny down. Pay only net shipping charges when books arrive. With these books and a low price "school set" of drawing instruments, obtainable at any store, a man can become master of drawing and earn $30 to $75 weekly.

LEARN AT HOME—Good paying positions open everywhere. Intense activity in manufacturing, railroading, building, etc., calls for more draftsmen.

Shipped on 7 Days' FREE Trial

CYCLOPEDIA OF DRAWING

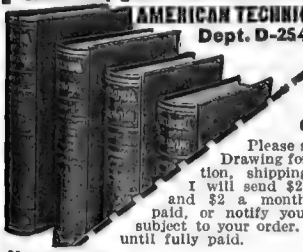
4 Volumes. 1650 Pages. Thousands of Illustrations.

Bound in genuine American morocco. Pages 5½ x 8½ inches. Covers all branches of Drafting—Architecture, Electrical, Structural Steel, Sheet Metal, etc. Teaches pen-and-ink rendering, lettering, free-hand, perspective, shades and shadows, working shop drawings, machine design, etc., etc.

50c a Week Only $2 a month if you keep the books. Coupon explains offer, good only within borders of U. S. and Canada.

Free Membership in This Society.—A Consulting Membership **given free** with each set—worth $12.00.

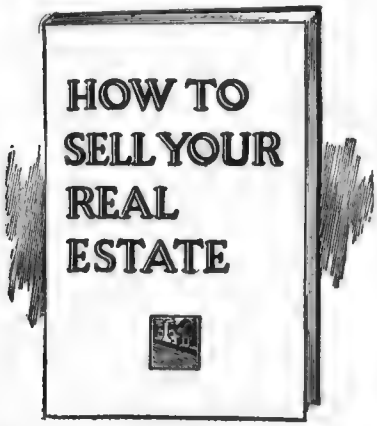
AMERICAN TECHNICAL SOCIETY
Dept. D-254 Chicago



AMERICAN TECHNICAL SOCIETY
Dept. D-254
Chicago, U. S. A.

Please send Cyclopedia of Drawing for 7 days' examination, shipping charges collect. I will send $2.80 within 7 days and $2 a month until $14.80 is paid, or notify you and hold books subject to your order. Title not to pass until fully paid.

Name .....
Address .....
Reference .....



This FREE Book

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Telegraph, Cable and Radio Dispatches

(*Continued from page* 1298)

one word each in the address of cable or radio messages, irrespective of their length or the number of separate words they contain; for instance, Havre de Grace, New York, East St. Louis are counted as one word each. In the body or text of a message, however, such names are counted and charged for at the rate of fifteen letters to the word in plain language messages; at the rate of ten letters to the word in code messages, and at the rate of five letters to the word in cipher messages.

In dispatches written in a mixture of plain and code language the maximum length of a chargeable word is set at ten letters or characters.

In dispatches written in a mixture of plain, code and cipher languages, the passages in both plain and code language are charged as code language, and the passages in cipher language are charged at cipher rate.

In dispatches written in plain language and cipher language, the passages in plain language are counted as plain language, and the passages in cipher language are counted as cipher language.

A sender may prepay a reply. To do so he must write before the address of the message the indication of prepayment, as well as the number of words prepaid for the answer; thus R.P. 10 (to) Lathrop, Paris, etc., the expression "R.P. 10" being counted and charged for as one word.

RADIOGRAMS.

Radiograms are messages which must be transmitted thru the medium of the ether by means of radiated electro-magnetic waves and may originate on board a vessel at sea to a distant inland point or vice versa. There has also been recently inaugurated a radio service between the United States and various European points, whereby radiograms may be sent to and from England, Norway and other nations in the same manner as cablegrams.

In general, the system of counting the words in a radiogram is identically the same as that employed in cablegrams; in other words, the "cable count." Names of ships are counted as one word each, irrespective of the number of letters in the address. In the case of two or more ships of the same name (which is not an uncommon occurrence) the line controlling the vessel should be included in the address, as in the following manner: "Smith, Wardline Steamer *New York,* via Cape May Radio."

Radiograms originating on land and destined for vessels at sea are sent by land wire to the coastal radio station nearest to the point or zone within sending and receiving radius of the vessel, after which the coastal radio station holds the message until it has establisht communication with the incoming or outgoing ship, as the case may be.

Before sending a radiogram to a vessel at sea the sender should first ascertain from the local ship news office or marine department of a newspaper as to the latest radio report received from the ship, giving her position or probable date of arrival or departure, as the case may be, so that the message may be properly timed. In some of the large seaports, such as New York, Boston, Baltimore, New Orleans, San Francisco, etc., it is well to first secure the above information from the local office of the radio system, as the latter is in a position to inform the sender as to the proper coastal station to route the radiogram, as well as rates and other necessary information. Ordinarily, however, any telegraph office will accept radiograms to and from ships and properly route and deliver them.

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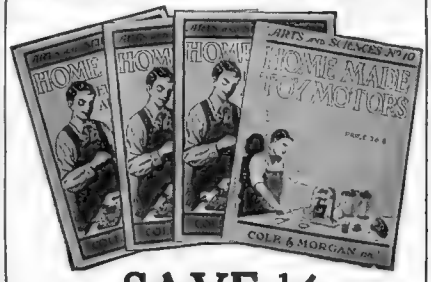

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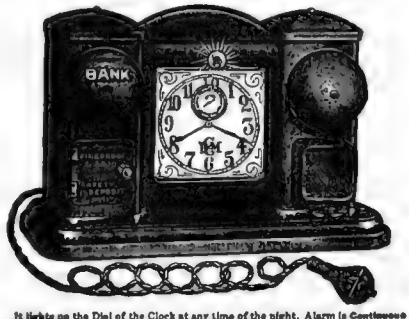

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The cut at the left, shows a beautiful Phonograph, *which you can build out of a common dry goods box,* similar to the one illustrated below. This machine is handsome in design and will be an ornament to any home. Its lines are simple and pure Colonial. All who have heard it, say it has

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which are so easy to follow, as they are completely worked out in every detail. Any person who has a few, ordinary tools—saw, hammer, plane, screw driver, and some sand paper—can now build a phonograph with our help, and with no chance for failure.

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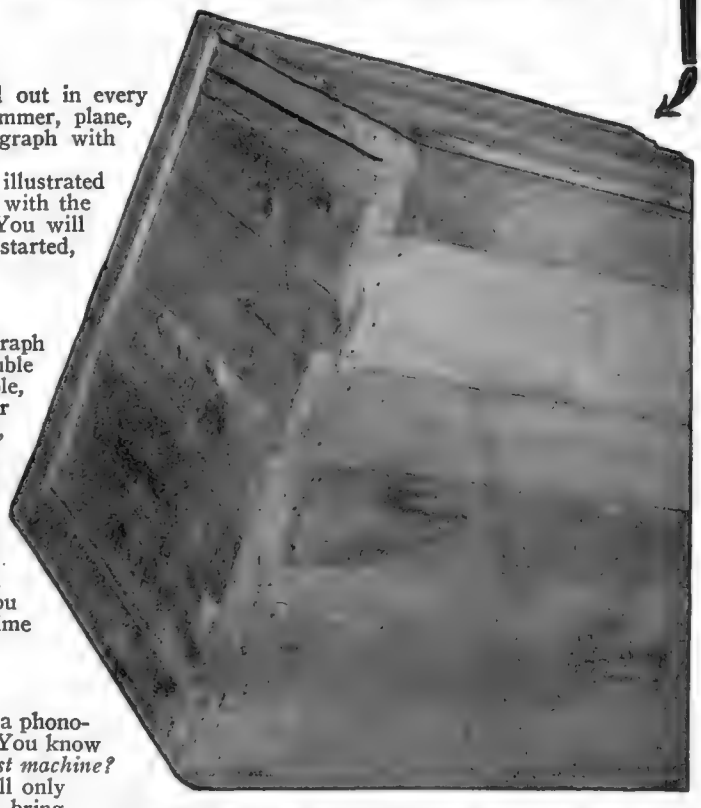

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Hello Mars!

By H. WINFIELD SECOR

(*Continued from page* 1250)

well, and it is not formed of any earthly combinations or codic conjugation with which you are familiar. Can you imagine what your first effort would be towards solving this problem?

For the moment we may even consider that you have at your disposal even the interplanetary wireless telephone, but of course in its infancy, so far as communication with the Martians is concerned.

Is it not a most interesting philosophical conundrum to try and think just what you would do in this case? Would you try to talk to the Martian and encourage him in the English tongue in your endeavor to find out what the word "gouka" meant? Or perhaps, if you are a linguist of high attainment, you might possibly try talking to him in several different tongues, of which there were at the last count, 420 different species on the face of the earth.

But we won't keep you guessing any longer, because we know you will undoubtedly tire of this reasoning, and in the next issue we shall tell you what this (supposed) Martian word means.

Looking at Fig. 4 once more, take a piece of paper and cover up the little animal at the left of the word r-a-t, and just imagine what a quandary you would be in upon your first sight of the word *rat*, even tho by long and patient study you had learned the outlines of the letters and knew that they constituted elemental parts of a certain language,—it matters not which one. Remember, the Martian could not talk to you, even tho he had a wireless telephone transmitter which reached the earth, because he does not know your language. And how are you going to ask the Martian in a language which you know nothing about what the word means, and what is still worse, how would you know the proper pronunciation of the word? The answer is, you *could not!*

But supposing that after you had been looking at this word for a long, long time, that suddenly one night an outline appeared alongside of it of an animal that looked like a rat! In other words, remove your piece of paper from over this part of the illustration on the left of Fig. 4 and lo and behold! you at once perceive that R-A-T equals a rat. All your difficulties have been swept away instantly.

And so it begins to look as if the only logical method by which to start a communication with the Martians in either direction is by means of *words and pictures.* This method is not entirely new, for several of our foremost astronomers have made this suggestion; but in the latest outburst from our radio and other communication experts, who are talking of sending radio or flash-light signals to Mars, or, in other words, dots and dashes of the Morse code, forming letters of a language which *we* know,—the homely philosophy and simplicity of the kindergarten rule have been entirely forgotten, it seems!

Picture yourself standing opposite a man whom you never saw before and whose language bears no similarity whatever to yours, and that by means of a semaphore or by a wireless instrument or perhaps a telegraph sounder, he starts shooting dots and dashes at you! Suppose the dots and dashes correspond to letters in *his* language. Can you by any stretch of the imagination conceive as to how you are going to interpret these dots and dashes and finally ascertain what in Sam Hill he is driving at?

(*Continued on page* 1304)

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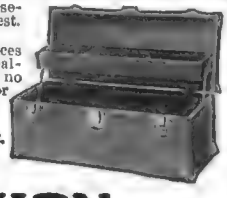

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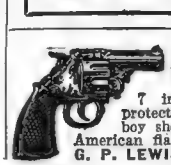

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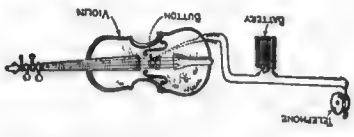
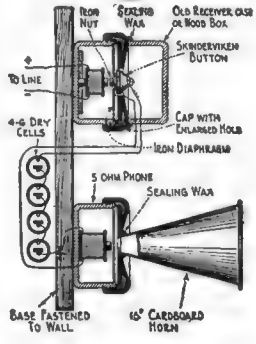
Actual size.



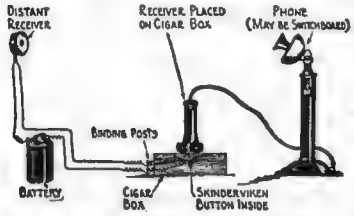
So much for its commercial adaptations! *You* can procure apparatus of the same type.

One of the main advantages of the Skinderviken Transmitter Button lies in its ultra-sensitiveness. You can place it in any position you like. It is the greatest invention in micro-phones and has won recommendations from men of high standing in the scientific world. It is being used all over the world. You can mount it most anywhere. Card board boxes, stove pipes, stiff calendars and hundreds of other places will suggest themselves to you. The buttons cannot be seen by any one in the room as they are so small and light. Only a small brass nut is exposed to the view.



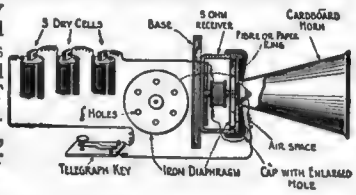
Full directions for connecting up the button for use as a detectophone are given in booklet which is sent with each button.

The only instruments needed to complete a detectophone outfit, in addition to a Skinderviken Transmitter Button are a receiver, battery, and, if desired, an induction coil.



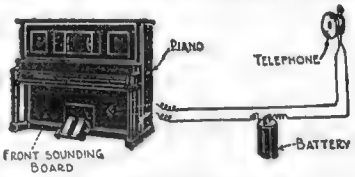
The Skinderviken Transmitter Button operates on one or two dry cells. It often happens that two cells produce too much current and the sounds are deafening. We recommend either one fresh cell or two worn out cells.

We have the utmost faith in this transmitter button. We guarantee satisfactory service or we will refund the purchase price. Boys—Young and old—send in a dollar bill RIGHT NOW! You can't lose. If you're not satisfied, you receive your dollar back. Isn't that fair?



AMONG electrical experimenters the button has created a sensation. It is not uncommon to receive unsolicited letters like these: "I received transmitter button today and I wish to inform you that it works great and is *the best I have ever seen or heard of for the price.* I will certainly recommend it to my friends. I wish to thank you for your good service."

"I have been using one of these transmitter buttons, and it has proved to be worth more than its value in my experimenting." "I received one (Transmitter Button) some time ago, and they are just O. K. for experimenting." "I have been using one of these transmitter buttons for experimental work and it certainly lives up to all you say for it *and then some.*"



Mr. H. Gernsback, editor of this magazine, who is the dean of electrical experimenters, said: "In the writer's opinion, obtained by actual elaborate tests, the Skinderviken Transmitter Button is probably the most efficient device of its kind on market today, due to its simplicity and other outstanding features. Should have a great future."

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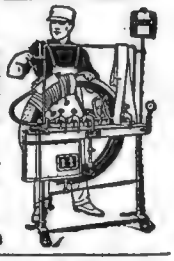

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Hello Mars!

(*Continued from page* 1302)

It is of course evident that as aforementioned, and granted that both parties have average intelligence, most likely one can make the other understand numbers from zero to nine, so that number combinations could be transmitted and interpreted—but think of hearing for the first time or, for that matter, a thousand times, a string of five dots and five dashes of the Morse code. In the other *man's* language it might mean "d" or "h" or "z" and again it might mean a house or a cat-boat or a three-ringed circus, for all you are concerned.

HOW DO WE LEARN FOREIGN "EARTHLY" LANGUAGES?

It is common to hear people say: "Why, that is easy,—when they happen to overhear a discussion of interplanetary language communication,—"If this is as hard as it sounds," say they, "then how do you account for the fact that a Frenchman readily learns German, or a German learns Dutch?" And yet it is commonplace! Very true, it is a common, ordinary everyday occurrence, but did you ever really stop to think about it at all, and how it takes place? Several very important and peculiar things happen when you learn a word of a foreign language. Supposing you are an American and that you visit France, let us say.

As you leave your ship and take a railroad train for the great city of Paris your attention is suddenly arrested by a large electric sign erected on a tall building. Remember, now, that you do not know a word of French, and assume that all of those around you knew not a single word of the English language. How would you find out what the illuminated word meant?

Possibly, if you nodded your head in the direction of the display a sufficient number of times to make the Frenchman near you eventually awaken to the fact that you were in doubt as to the word on the sign, he would make some bodily motion to give you some inkling as to what the word meant. But unless you happened to live to be so old that you could look thru a marvelously high-power telescope a couple of thousand years from now, which would magnify the Martian himself, so that you can see his bodily movements, then it is evident that you are going to have a merry old time finding out what a similar strange word, if presented to you in the form of illuminated letters on Mars or otherwise could mean.

While speaking on the subject of how we assimilate the language of another nation, it should be remembered that never do we learn a word of a strange tongue and its full meaning *unless we see in some way or other a comparative picture of what the words means.*

The American Doughboys in France picked up many French words. Of course they did, why not? The French man or woman would show him a bottle or cup, or saucepan or stove and utter at the same time the French word. Naturally, as he is an intelligent being, he will know that the particular word uttered in each case represents the object which was shown him.

So once more we see that it is in every case the simplest and the shortest method and in fact the *only logical method* whereby to teach the language of one nation to the other,—that is, by *words and pictures* simultaneously, or by a similar and equally clear illustration.

Another very important element in interlanguage relations is the fact, particularly in Europe, that there are a dozen and probably several dozen different languages, so-called, which have a very large number of common generic roots, and this explains all

(*Continued on page* 1306)

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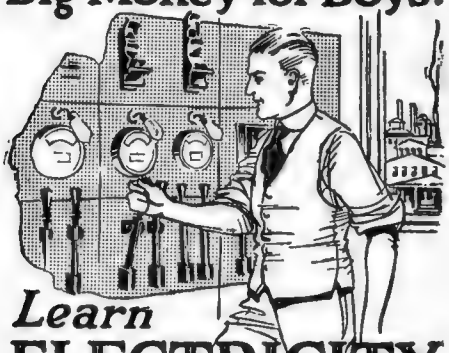

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Hello Mars!

(*Continued from page* 1304)

the more clearly how it is, for example, that an European comes to America and tells you he speaks six or eight languages, or possibly ten. Of course he can do it, and so would you as an American, if you were continually thrown in with people of other nations as the people of Europe are intermixed, some of the countries being very small, and if the languages of these different peoples had numerous generic roots similar to your own. But when you meet one of these high-brows ask him if he speaks some radically different tongues, such as English, Chinese, Eskimo, Indian, Russian and Turkish, which have no similar generic roots. That is another story, you can bet!

HOW A CHINAMAN LEARNS ENGLISH.

Fig. 5 shows an interesting case right in line with the would-be Martian conversationalist's theories. This experiment has actually been tried out as a professor of languages explained to the writer, and shows just what he has always contended,—that, lacking a picture or verbal description together with a word of a strange language, or else some other visual effect, such as a motion of the body, jerking of the head, or pointing of the finger, etc., that it is practically impossible for two exponents of two radically different languages to interpret a single word of what the other is talking about.

The illustration at Fig. 5 shows how a Yankee and a Chinaman were placed on either end of a telephone line. This happened some years ago in the South Pacific Islands, where the linguist aforementioned was stationed at the time, and this gives a very good illustration of what we have been talking about, as the two languages are widely separated and have no comparisons in common. If you think they have, go into the nearest Chinese laundry and get John the Chinaman to wish you a "Happy New Year" or some equally plain or well-understood salutation in his native tongue. !**!!-?-* Would you *ever* recognize it?

Well, to make a long story short, the "Yank" gabbled away at the telephone at his end of the line—and the "Chink" did likewise. They kept this up for a good many days, in fact for several months all in all, and the sum total of all this talking and wasting of dry batteries,—not to mention the time which might have been enjoyably spent fishing on the coral shores,—was *NOTHING!*

Very few linguists have attempted to learn Chinese, but that language is no more difficult for a moment than trying to learn *Martian;* for you can go to China (if you have the price) or for that matter get acquainted with a Chinaman who speaks English, right in New York City or your home town, and after spending several months in special sessions with him you will perhaps have an idea of a few (?) Chinese words. Some languages are simple and some not so simple. Ours is fairly so, and the Chinaman thinks his is first class, altho his children spend the greater part of their lifetime mastering its intricacies.

There are about 16,000 different signs used in the Chinese language to indicate the different objects. If you want to write the word house, you make a sign like this and if you want to become a real high-class Chinese college man, you must learn over twice this number, or 40,000 signs each signifying a different object. Suppose the Martians have such a language? How do we know? We don't; and even with word-pictures it would be a slow job, for their objects might not be familiar to us.

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WHAT THOMAS A. EDISON AND SIR OLIVER LODGE SAY.

Thomas A. Edison believes, according to a recent publisht interview, that contrary to the contentions of many eminent radio scientists, the Heaviside *ionization layer* in the upper atmosphere of the earth would prevent earth-borne radio signals from passing out into interplanetary space—that these earth-borne radio signals would be propagated into interstellar space for hundreds of thousands of miles by means of the ether waves, and that it is possible that the Martians, if there are such beings, had received these signals, altho they might not have the slightest idea as to what they might mean.

As he jocularly remarked in an interview at the recent celebration of his seventy-third birthday, and granting that the messages radiated by our powerful trans-Atlantic radio stations had reached such distances as Mars, how do we know whether they are received or impinge upon a *human* or a *chimpanzee?* It is the opinion of the writer that the stray signals to which both Dr. Marconi and Dr. Tesla refer to, as having been heard in their long-distance radio stations from time to time, are either signals from unknown distant stations or else they are static disturbances caused by disturbances of the electrical equilibrium of the atmosphere, or possibly of the earth itself.

Now that everyone in the scientific world is taking a crack at the interplanetary communication game, Sir Oliver Lodge, the well-known British scientist now touring the United States, made the following suggestion:

"Nonsense," said he, when asked if he thought it possible to communicate with other planets by *wireless telegraphy*. "It would be possible to place an immense geometrical figure, say on the Sahara Desert and then, if the inhabitants of Mars are of a high order of intelligence, they may be able to distinguish the figure and determine that it had been the work of man. Geometry is a universal science, and it is not unlikely that if they are of a higher order of intelligence than we that they can interpret the gigantic figure as an effort at communication." (See illustration, Fig. 6.)

"ILLUMINATED WORD PICTURES" FOR THE MARTIANS.

A writer in the *Western Electric News* recently made the following suggestion which seems almost comic and, in fact, tragic, when we come to figure the bill, but still it has the essence of sound logic in it, when it comes down to real Earth-Martian intercommunication. He suggests that we take a large piece of ground, such as the whole State of Illinois, and install upon this nice flat piece of ground several million 1,000 candle-power flood lights fitted with reflectors and shutter attachments. These, of course, would all point sky or Martianward, then he continues: "Choose a dark night and start the flood-lights working. I would suggest that a complex net-work of shutter control circuits he hooked up with some automatic printing telegraph machines, so that by shoving a piece of perforated tape thru the automatic transmitter the whole set of lamps could be illuminated in any pattern desired

"For instance, an outline of the United States could be shown by the lamps (see Fig. 7 herewith) and at the bottom *huge letters, about three miles long*, can spell out the words 'U-N-I-T-E-D S-T-A-T-E-S.' By the aid of their modern ultra-powerful telescopes, the scientists on Mars can or should see at a glance what we were driving at, and it would not matter whether they saw the period mark or not."

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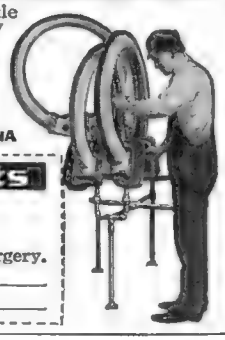

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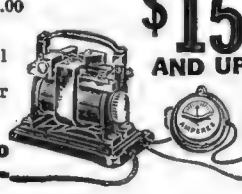

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ful electric searchlight, shown in the accompanying photographs, to utilize a battery of 200 of his 1,250,000,000 C. P. searchlights in one gigantic bank and to concentrate their rays into one powerful beam of light, which it is figured that the Martians cannot miss. It is claimed that this flash of light would be visible on Mars as a star of the seventh magnitude, which is easily picked up by our telescopes.

The accompanying photographs were taken on the roof of the Sperry Gyroscope Company's factory in Brooklyn, New York, and certainly shows in a very interesting manner the great power of this most powerful electric searchlight ever built. Two hundred of these searchlights would give a total candle-power for Martian signaling of 250,000,000,000—rivaling the sun itself.

The fan arrangement of light beams in one of the photos was formed by an arrangement of six large reflecting mirrors which produced a very brilliant and spectacular effect, as will be seen. See Figs. 1 and 1-A.

MYSTERIOUS DOTS AND DASHES MIGHT FORM MARTIAN PICTURE.

Mr. H. Gernsback has suggested that if the proper interpreting apparatus was brought into play, that the mysterious dots and dashes received on the radio antenna of the Marconi station, and also those cited by Dr. Tesla, might yield some very surprising results. In other words, if these were recorded, as for instance by a light beam controlled by a set of magnets connected to the radio receiving apparatus antenna as shown at Fig. 8, on a sensitized photographic cylinder, fitted with a threaded axle or shaft, which would cause it to move longitudinally as well as rotatively, past the fluctuating light beams, that when this was unrolled from the drum there might be developed a word-picture or such as we have shown in Fig. 8.

Now, there is nothing startlingly novel about this apparatus. As a matter of fact it has been used about ten years ago for the transmission of pictures by radio and considerable success was had with this method. The pictures can be transmitted entirely either by dots or by dashes—it makes no difference which, and a minute's consideration will show that with a transmission of this kind no regular sequence of the dots or dashes is feasible or even possible.

In other words, the time element between the succeeding dots or dashes all vary and will never be alike. Due to these differences in time between succeeding signals, the radio picture is built up.

As Mr. Gernsback points out, were the Martians to send us such radio pictures, they would probably first pick out some astronomical fact, as for instance the planet Saturn with its rings. Alongside of this would then appear the symbol in the Martian language whatever they might be.

This is shown in our illustration, Fig. 8. If the Martians were to send us pictures such as these, extending over a number of months, it would be very simple for anyone versed in deciphering foreign languages to become acquainted with the Martians' alphabet or language, as the case might be, and very soon we would master the language without much trouble. By this method the Martians could show us how they transmitted the messages to us, and we in turn could then follow suit and answer back by a like method.

This idea was prompted by the fact that it is apparently almost impossible for us Earthians to interpret intermittent signals such as dots and dashes or short and long flashes of light hurled toward us by another planet, into intelligible language—and as the Martians are supposed to be far more intelligent and more scientifically developt than we, it is possible that some such scheme as this may be eventually worked out by our scientists. Many wonderful things have

happened in the past twenty-five years and in the past one hundred years there has been a greater advance in science than in all the centuries that went before.

SOME OTHER OPINIONS.

Dr. James Harris Rogers, of Hyattsville, Maryland, the well-known inventor of the underground and underseas wireless, has recently announced that he is preparing to set up delicate radio receiving instruments in his laboratory capable of responding to signals up to 150,000 meters wave length. This is said to be 50,000 meters greater wave length capacity than that used at the Marconi station, where the mysterious signals have been noticed by Marconi himself and which he believes to have come from some far distant planet—such as Mars.

In a recent interview Dr. Nikola Tesla had the following to say: "That the planets are inhabited is a foregone conclusion. I believe that the time has come for a serious attempt in the direction of interplanetary communication. We can begin by erecting a plant for transmitting the signals conveying the knowledge of numbers, which would be the simplest truth that could be communicated to the Martians or other worlds' inhabitants, and which would be answered immediately if the planet is populated by a race as civilized as ours. Once the first step is successfully carried out, it would then be very easy to install more elaborate apparatus *for the transmission of pictures,* by means of which the most intricate thoughts can be communicated."

Another writer on interplanetarian communication, believes, like Sir Oliver Lodge, that geometric figures would be very plausible as the first stepping stone to open up relations between the earth and the Martians, and the sponsor of a very interesting theory, Mr. J. G. Carter of Clifton, Ohio, puts forward the suggestion that the snow flakes which fall during our winter season may even be influenced in a positive manner by agencies controlled by the inhabitants of other planets, such as Mars. This theory is based on the fact that there is a very large number of different geometric designs assumed by falling snow flakes.

In closing, we may very well take a few moments to digest some remarks of an interested reader, Mr. Martin C. Hansen, on the subject of communicating with Mars.

"From some recent newspaper clippings I have noted the following statement: 'Some wireless experts believe we shall soon be able to exchange wireless messages with such planets as may be inhabited.' YEH! says I. And again, one article claims Venus to be a 'younger' sister of the earth. Well! well!

"Now, if Venus is so much younger than the earth, then we must also concede its race of inhabitants are also younger, both in nature and inventions. If this is true then we may have to 'feel' *them* for radio signals for generations to come, before we can hope to get any answer. And just as Martians are supposed to have done the same thing with us for hundreds, if not thousands of years; so will we have to keep on signaling the Venerians.

"To return to the subject of intellectual Martians. If the Martians are so much wiser than we by a million or more years, *then they have NOT tried to wireless us for the past thousands or more years,* as they certainly ought to have telescopes and other instruments to actually ascertain what we are doing along the line of inventions and mechanics, etc., and they would not be such fools as to signal us, *when they would know we had no instruments of any kind to record their signaling.*

"If Venerians are a million years younger than we (if we knew this to be true), then we are certainly the most consummate fools in believing we can send messages to them because they are as yet the lowest cave men of the stone age."

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Promotion and better pay is up to you and not the boss. The big pay checks go to those who can think, act and do things for themselves. Training will make you a master of your work **and place you in the job you want.** There are no two ways about it; while you ignore the benefits of training you are **dodging a better job.** Without interfering with your work you can prepare for bigger pay right in your own home—after supper in some of the hours you now waste. The thousands who have marked and mailed the Coupon to the right have doubled and trebled their pay. That is just what you can do—so do as they did. Send the Coupon.

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Light and Power from the Sun

(*Continued from page* 1241)

A year or so ago there was described in this journal another solar power plant and an elaborate scheme was detailed and illustrated therein for revolving glass heating units in perfect synchronism with the sun by means of an electric-clock regulating device, so that not only did the complete bank of solar units rotate from east to west, but also the angle of the surface of the units was tilted so that this surface was kept exactly at right angles with the solar rays, which means that the surface of the glass tank or units must swing from right to left in the course of the daylight period from eight to ten hours, and also they must be tilted from a nearly vertical position in the morning—thence to a horizontal position at noon—and then once more to an approximately vertical position again in the evening.

In Mr. Willsie's solar power plant there is a trough arranged at the bottom of the glass heating tank into which the heated water at a temperature of 150 degrees or more runs off thru a pipe into the storage tank which in insulated with layers of dry sand. Mr. Willsie explains that *the water will remain hot from four to ten days* when stored in this tank, and here we have the key to a very novel principle involved in Mr. Willsie's plant, viz., that he can run his engine and dynamo at night without any storage batteries and obtain electric lights, etc., which he actually did at his Arizona plant.

Originally, however, when the plant is put into complete operation, the heated water runs from these storage tanks into the sulfur dioxid engine and boiler system, as shown clearly in the diagrammatical illustration herewith. Sulfur dioxid, as is well known, has a low boiling point, so that it can be placed in the boiler and heated up, allowing the hot water to come into contact with the boiler tubes containing the sulfur dioxid. When the sulfur dioxid in the boiler commences to boil, you then obtain the necessary *sulfur dioxid steam* wherewith to run the engine. In other words, instead of using the fire to make steam in the boiler, hot water is used instead, which originally obtained its heat from the sun directly.

As the sulfur dioxid steam leaves the engine cylinder it is not exhausted into the open air, owing to its initial high cost, but it is exhausted into a series of pipes over which cold water is sprayed. This water, in the case of irrigation plants, such as that developed by Mr. Willsie in Arizona, is the same water that is pumped by the engine (the pump being a separate machine connected to the engine by belt or otherwise) for irrigation purposes, so nothing is lost in this stage, but the sulfur dioxid steam is condensed and is then re-pumped or otherwise directed back again into the boiler, only to be heated all over again by the hot water coming from the sun tanks.

As Mr. Willsie has pointed out, electric light was had at night at his Arizona solar plant, which was actually made by the rays of the sun shining during the preceding day, a *seeming paradox*, were it not for the facts explained heretofore—that he has found it possible to cause the hot water to retain its quota of heat energy even for several days at a time, when it is stored in properly built tanks insulated with layers of dry sand, or other heat insulating materials.

Where this may not be practicable, we can always have recourse to electric storage batteries, in which the dynamo would pump electric energy during the day on

certain days. Then whenever the battery became sufficiently low in its charge, the electric energy required could be drawn from the storage battery at night or at any other time. Under certain conditions it would probably not be necessary to operate the solar plant to charge the storage battery more than one day a week, as, for instance, where such a plant was installed (of the proper size, of course) for, let us say, lighting a private dwelling or farmhouse and outbuildings, etc. By having a sufficiently large storage battery which would generate the energy required for lighting purposes for a period of one week, this could be taken care of by charging for just one day complete.

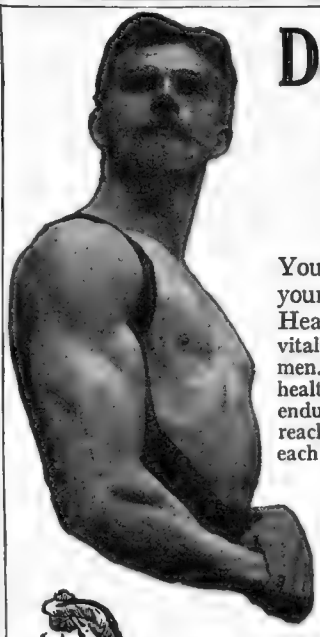
At any rate, it is a case of getting *something for nothing,* so far as spending the "coin of the realm" is concerned, and this is what most people are worried about today, with the H. C. L. still soaring skyward. Of course, it is not something for nothing in a strict sense of the word, for we are utilizing the *energy of the sun's rays.* The foregoing covers the doubt exprest by many people when they first hear about solar energy plants, for their invariable and natural first question is "What about cloudy weather, and, even tho we have quite a number of sunny days, you may even have three or four cloudy days in one week?" This is very true, but the aforementioned explanation as to charging the storage batteries but one or two days a week, or possibly, as Mr. Willsie points out, by suitably storing the heated water in special storage tanks, explains this problem.

And, anyway, it will probably not come to pass very soon that we shall be selling and installing solar electric lighting plants on the roofs of apartment houses, in the northern parts of the United States, as if these were as cheap as sand in the Sahara Desert, the average city dweller would not bother with it, when he can spend $2.00 or so a month and have the local electric lighting company supply all the "juice" he requires without bothering his head about it. But it is another question when we come to consider the vast stretches of land such as those in the South and Southwestern parts of the United States, where the fight for survival of plant life is seen to be dependent upon the all-important quantity—*water.* And here is where these solar plants should and will find their ultimate goal and adoption in large quantities, for it is uneconomical under any consideration, to attempt on a large scale an irrigation of such large tracts of desert by means of *coal or oil driven plants,* as these fuel commodities are becoming more expensive each year.

TRANSMITTING ENERGY.

Wireless telegraphy and wireless telephony suggest the possibility of transmitting energy by wireless waves. "Suggest" is right—we'll say. A Rumanian engineer, M. Constantinesco, has been experimenting in England with a method that seems novel.

He uses a tube filled with water or some such liquid, in which vibrations of the nature of sound waves are produced at one end and the energy is reconstructed at the other end in a mechanical form. The details of the apparatus are kept secret, but Constantinesco's researches have been financed by the British Government, and it has already been applied in the mechanism that stops the discharge of bullets from the rapid firing gun of an aeroplane each time that the blade of the propeller passes before the muzzle. This is what makes it easy to fire 2,000 shots a minute thru a propeller making between 1,000 and 2,000 revolutions a minute. (But what has this got to do with the wireless transmission of energy? Leave it to the daily "news technicians."—EDITOR.)



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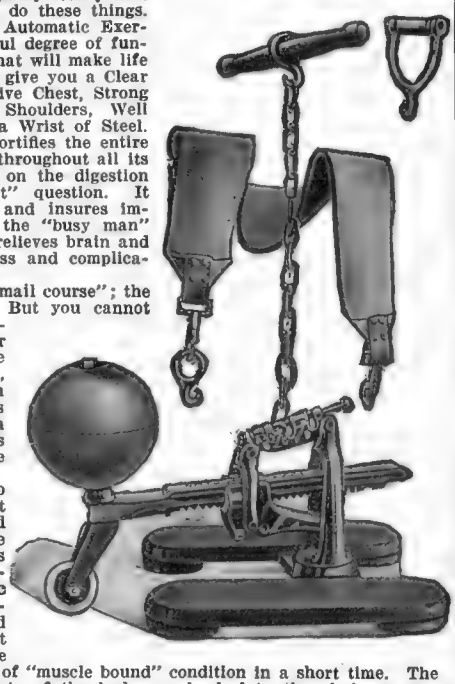

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Thighs	754 lbs.	2,000 lbs.	1,246 lbs.
Knees	754 lbs.	1,800 lbs.	1,046 lbs.
Calves and Ankles	410 lbs.	892 lbs.	482 lbs.
Back	508 lbs.	1,382 lbs.	874 lbs.
Shoulders and Arms	356 lbs.	641 lbs.	285 lbs.
Neck	185 lbs.	375 lbs.	190 lbs.
Biceps	87 lbs.	280 lbs.	193 lbs.

His fingers show an average gain in strength of 100%.

Records of one month's results by Mr. Thomas Waring, Hamilton, Ont., Can.

First Record	Second Record
159 lbs.	411 lbs.
134 lbs.	461 lbs.
.....	.....
54 lbs.	88 lbs.
41 lbs.	86 lbs.
20 lbs.	54 lbs.
.....	.....
Abdomen	
46 lbs.	102 lbs.

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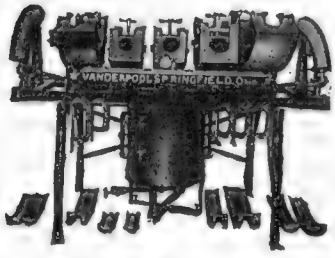

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has capacity of $300.00 worth of work a day—repairs tires just as they are made at the factory. Investment small and immediate returns. Write today for full particulars and FREE TIRE REPAIRING MANUAL.

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In answering address Dept. L

Electro-Medical Frauds

By JOSEPH H. KRAUS

(*Continued from page* 1254)

concern, in advertisements, claims that low sounds and whispers are plainly heard and altho it may be used in a few cases, the claims are misleading.

The device is a small oiled silk artificial drum having a waxed silk thread attached to it. A piece of flexible rubber tube is likewise included for insertion of the "phone." The total price which the Morley concern charge for this device is $5.00, its cost being about 25 cents. Something similar was originally constructed in 1852 by Toynbee, altho the heads of the Morley concern claim the invention, having secured several patents on the same. It is nothing but an artificial drum head, which is inserted into the ear. Indications for the use of the same can only be determined by a *competent aurist,* after a most rigid examination.

Another drum of a similar nature is being sold by the Artificial Ear Drum Co., which is a rubber contrivance called a *Medicated Ear Drum.* Each end of this is enlarged with a constricted portion in the center. All that is necessary is to push the device into the ear and Zowie! you can hear!

Likewise, we have yet to see where a case of discharging ears has been remedied by a similar device. The Wilson ear drum is another of the wonderful w'reless telephones for the ears for which great claims and testimonials have been advanced.

Quite different from the above devices is one even now on the market and claiming International Notoriety, called the *Macaura blood circulator* shown in Fig. 6. The inventor organized institutes and gave lectures for the sake of perpetrating the sale of his blood circulator or pulsator. This prince of fakers, Dr. Macaura, then went so far as to rent auditoriums and gave two shows weekly. His advertisements appeared the world over. Finally, after having the most marvelous advertisements, rivaling everything in splendor and imagination in various papers, announcing the discovery, and after having shifted his scene of operations thru various countries, the self-styled "Doctor," who had swindled so many thousands, was imprisoned for three years and fined $600.

It is here called the Cirkulon, and costs over $15.00. It is a simple hand-operated, vibratory device which will do none of the things claimed for it, and is far less efficient than the vibratory massage devices being sold at a much cheaper rate.

The greatest series of ridiculous and nonsensical devices are those known as the *gas pipe* cures, among which are found the Electropoise, Oxydonor, Oxygenor, Oxypathor, Oxytonor, and Oxybon.

These wonderful discoveries consisted of a nickel plated gas pipe, beautifully finished at both ends, with two wires running into the same. This cylinder was about 3½ inches long and weighed about 5 ounces. At the end of the wire is a small disc which is attached to the wrist or ankle, or both, by means of an elastic band and buckle, according to the treatment. In general, they are filled with either *nothing* or else a worthless compound, such as carbon, either in stick form or pulverized, iron filings or perhaps coke dust.

The first two of the aforementioned devices were *empty, altho claimed* to possess remarkable *electric* (?) qualities. The Oxygenor was claimed to *oxygenate* the blood of its victims. This fake was filled with "rare and costly" materials, according to the makers (sulphur and charcoal by analysis). The ozone so generated traveled directly "thru the pores" and was so pow-

erful that a *regulating cord* had to be attached to the device.

It cured everything from chicken-pox to epileptic fits and from measles in childhood to heart failure at old age. When placed into a tube of water it absorbed all the oxygen from it and *pumped* it into the blood—(at least the inventors said so). Particularly in view of the fact that water is made up of two atoms of hydrogen and one of oxygen, we are hence, questioning what the water looked like after all the oxygen had been removed!

Another of these same *gas pipe* frauds was guaranteed to cure everything except cancer and tumor, on which it had no effect. Of course, the makers had to admit that there was some *trivial* disease that could not be cured, as a *cure-all* is sometimes looked upon as being a fake, but if glaring headlines state that we can cure everything but tumors, why, of course, that sounds more reasonable.

These devices were sold at prices ranging from $10 to $35. Their actual cost not being more than 50 cents to one dollar, and their actual value being about .00007 mills, i. e., they would bring this as *junk*.

The magnetic blanket shown in (Fig. 8) is another of the magnetic frauds which need not be discust at any great length as magnetic devices have already been described. It is another method of extorting the "coin" from an unsuspecting public.

A wonderful seller at one time was the *vacuum head cap* which stimulated the scalp and induced the naughty hairs which the great bald headed man desired, to stop playing hide and seek and come out for a little air. It just seemed to suck this hair out. This rubber cap, connected by a hose to a pump operated by foot power (or a motor driven suction device if the person had the wherewithal to pay for the same), was clapt on the head and placed into operation.

As to the fallacy of the *modus operandi*. When a suction device is applied to any part of the body, it causes the blood to be drawn to that part, *but at the same time causes a congestion* in the superficial veins, arteries, and capillaries, hence, the much desired results are not produced.

In addition, it may be of some slight value to note that the hairs are only modifications of the skin and consist of the same structure as that membrane. When therefore, once the root of a hair has been killed, and its follicle destroyed so that a shiny bald pate presents itself, it is impossible to coax any hair from the head.

Storage Battery Repairing

By HENRY KLAUS

(*Continued from page* 1277)

battery out of an old one, altho this is not the case every time. A method of refilling the old frames was given in a back number of the EXPERIMENTER, but they would have to be sawed off in order to get at them and then welded back on. It is better to put in new plates and refill the old grids for use in small cells which can be sold to run toys for kids.

A battery with the plates short circuiting will show little or no voltage, while one with the active element gone will give the normal E.M.F. but hardly no amperage.

When the plates must be taken out you will be careful and not spoil the rest of the outfit. Ordinarily it is practical only to take out one cell at a time. The connections between the cells must be unscrewed or unfastened if possible or else sawed in two. The pitch around the ends is melted and the plates pulled out as shown in the diagram. We have used two methods for this, the blow torch, and moderately high pressure steam. The first is more practical because it is more convenient, handier,

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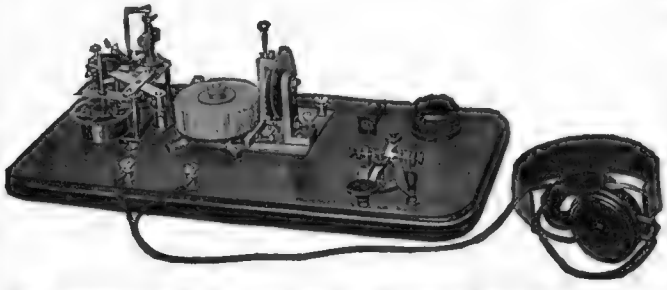

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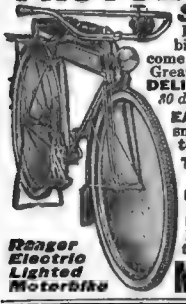

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and cheaper, altho more care must be taken not to burn the wood or the hard rubber covers and jars. If the hard rubber is accidently heated too much it must be held in the right shape while it is soft.

A common trouble is a cracked jar. A supply of the sizes most used would be a good investment. When they are not broken too bad we have found a recipe in a back number of the EXPERIMENTER that worked well. Also, when only one of two adjacent cells is cracked a home-made celluloid jar (EXPERIMENTER) did the work nicely.

Be sure you don't get the cells reversed when you put them back in. They are pusht down as far as before and the pitch melted again. The connectors are soldered together with the electric welder as the picture shows.

The carbons from old flashlight batteries are ground to a point for use on the electric soldering outfit. If a high amperage battery is used it gets red hot the moment the contact is made. Always connect it to negative pole.

A still for making the distilled water is given in the diagram. It can be put in glass jugs and sold, at a good profit.

A few hints.

Don't fill the cells more than ½ in. above plates.

Don't pound the plug to get it out of the terminal lug, loosen it with a pincers.

Keep the vent plugs out while charging.

Wear a rubber apron if you have one while working on batteries.

If you file a soldered joint down smooth don't leave the filings on the top, it may short-circuit. Acid or water spilled on the battery may do the same.

Home-made 110-Volt, 60-Cycle Induction Motor

By H. H. PARKER

(*Continued from page* 1272)

about three pounds will be required. Care should be taken that the coils are well insulated at every point from the iron core.

Assuming that all coils are wound in the same direction, connect the end of one coil to the end of the next, the beginnig of that to the beginning of the third, and so on. This will leave the beginning of the first and the beginning of the last to be connected to the terminal block (Fig. 1, 12), and so to the 110-volt A.C. 60-cycle mains. Fig. 12 shows one method of terminal block construction: two 1" by 2" fiber blocks held together by the terminal bolts. The inner block is held by a 5/16" carriage bolt, which also acts as the top clamping bolt for the stator core; the square head being countersunk in the fiber prevents the blocks from turning.

The rotor must be thoroly insulated with thin fiber, paper or tape and shellac before starting to wind the coils. These are four in number, one surrounding each rotor tooth, tho to do this it must have a right-angle turn. There are two ways to wind the rotor: coils wound over a wooden form, taped and bent into place before inserting the bolts and fiber posts, or assemble these and wind the wire directly on the core and getting the turns as even as possible under the conditions. No. 24 D.C.C. wire is used for the rotor, using as much as will go on, but taking care that about the same amount is used on each coil so that the rotor will not be unbalanced when the motor runs. The windings are short-circuited: assuming all coils wound in the same direction, connect the four inside ends together and then the four outside ends. Soak the coils well with shellac or insulating varnish and allow to thoroly dry. For protection from injury, the stator coils may be wound with a layer of heavy string, or covered with tape and shellacked.

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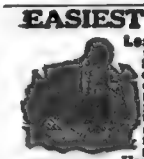

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In assembling the completed parts of the motor, see that the rotor turns freely without touching the *pole faces* or the *stator coils*. At least 1/32" end play but not more than 1/16" should be allowed the shaft. The air gap ought to be practically even (1/32") all around. Any size holes can be drilled in the feet to screw the motor to its foundation.

If any other frequency is used, the motor speed in revolutions per minute may be found from the formula

$$S = \frac{2 \times f \times 60}{p}$$

where "f" is the frequency in cycles per second, and "p" the number of poles, four in the case of this motor.

Talking Over a Sunbeam

By PROFESSOR A. O. RANKINE

(*Continued from page* 1263)

would open and close. In actual practise, the movements of the diafram are extremely small—a few thousandths of an inch only—and it would be extremely difficult to make the grids at once so fine and so rigid as to operate satisfactorily. The author's modification of this method, as will be seen later, surmounts this difficulty.

Graham Bell's second device is much more practicable. It depends on the fact that a vibrating diafram is constantly changing its curvature, first being flat, then convex, then flat again, then concave, and so on. By silvering the diafram, thus making it a reflector, and allowing light to fall upon it, the reflected beam is made more or less divergent according to the shape of the diafram. The latter, being set in vibration by speech sounds, thus causes the amount of light received at a distance from the reflected beam to fluctuate in the manner desired. It was with this instrument that Bell first communicated speech by light, and he called it a "photophone."

After Bell's experiments there was a long period during which little was done. But about 1900 the German physicist, Ernst Ruhmer, made a long series of interesting experiments. He attacked the problem from a different aspect. Starting with an electric arc, he devised means of causing small fluctuations in the arc current, by using a microphone. He thus succeeded in making the arc itself change in brightness in accordance with speech vibrations. These light variations were projected to a distance by means of a searchlight mirror, and received on selenium in the way already described. Ruhmer claims to have telephoned in this way to a distance of several miles. But the method suffers from several disadvantages. In the first place it is limited to the use of an electric arc, and thus one cannot use sunlight, which is very much more efficient. Also it is very difficult to keep the arc in the necessary sensitive condition—it continually requires adjustment.

It was these considerations which caused the author, when asked in 1916 by the British Admiralty to re-open the investigation, to revert to the general principles underlying Graham Bell's methods. The device which the author has produced, and, to some extent perfected, depends on the fact that it is much easier to move a beam of light than a material grid, and that it is necessary in some way to magnify the very small movements which occur when a diafram vibrates. Figure 2 is a diagram showing the essential features of the transmitting apparatus. On the right hand side of the diagram is shown a trumpet at the end of which there is a phonograph sound box. At the place where the needle is ordinarily placed, there is rigidly attached a small mirror, about ½ inch in diameter. If speech sounds enter the trumpet the middle of the diafram vibrates and actuates the lever so that the small mirror executes angular os-

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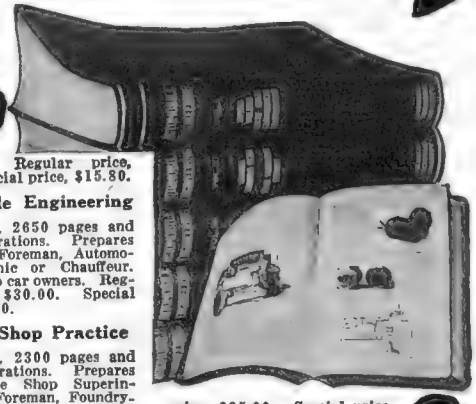

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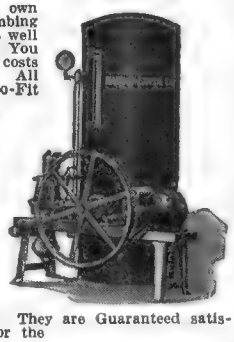

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cillations of small extent about an axis perpendicular to the diafram. Light from a source, such as an arc, or, it may be, the sun, is focust by means of the first lens upon the vibrating mirror, whence it is reflected to the second lens. The latter is arranged so that the vibrating mirror is at its focus, and the beam of light is thus made parallel, ready for projecting to a distance. Close up to the first lens is placed a grid, with spacings equal and alternately opaque and transparent. A second exactly similar grid is placed close to the second lens. The incident light is thus split up into segments (indicated by the unshaded parts) and these segments are reflected by the small mirror to the second grid. Now when the small mirror turns through quite a small angle, the reflected segments of light turn also, and the amount of light penetrating the second grid evidently depends on the position of the vibrating mirror. *In the diagram the position shown is that in which 50 per cent of the maximum is being transmitted.* When the vibrating mirror is set in oscillation by speech sounds the light filaments shown on the left hand side of the second lens get broader and narrower and we have the fluctuating beam of light which is required. The advantages over Graham Bell's method are obvious. The grids need not be inordinately narrow, provided the distance between them and the vibrating mirror is considerable. The grids themselves do not move at all, but we still get the effect of a shutter which is controlled by the speech sounds.

A photograph of the mounting of the vibrating mirror and the sound box is shown in Figure 3, and Figure 4 is a photograph of the whole transmitting apparatus mounted for use. In this case the sun is being used as the source of light. The sunlight falls upon the large mirror shown on the left-hand side, whence it is reflected thru the first grid on to the small mirror, thence again thru the second grid and the projecting lens. The apparatus is mounted on the equivalent of a gun mounting and provided with sights so that the beam of light may be projected in the desired direction, and thus caused to fall upon the collecting lens, which concentrates the light upon the selenium cell.

The reproduction of the speech sounds by the selenium is extraordinarily faithful. It is easy to recognize the voice of the speaker. Of course, for conversations to be carried on, *there must be two transmitters and two receivers.*

It remains to add a few remarks concerning the ranges over which speech can be transmitted in this way. Everything depends on the brightness of the source of light used, and the sizes of the transmitting and receiving lenses or mirrors. The sun is the best source of light. With it, and using lenses only 6 inches in diameter for transmitting and receiving, speech is readily audible 8 (eight) miles away. There is no reason why, with larger apparatus, and more sensitive receivers, this range should not be greatly extended. It is necessary, of course, to have an uninterrupted straight line between sender and receiver. Fog, also, interferes to some extent, altho, owing to the fact that selenium is very sensitive to red light and this light penetrates fog better than blue, the interruption is not as great as might be supposed. The curvature of the earth will impose the ultimate limit of range, and for this reason telephony by light could not be a substitute for the electrical wireless telephony which is now developing so rapidly. But light ray telephony has the considerable advantage of *complete secrecy.* It is only those upon whom you purposely shine the light who will hear what you say. For this reason telephony by light over comparatively short ranges, particularly between ships at sea, and between hills in sunny countries on land, may in the future prove of considerable use.

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See page 1235

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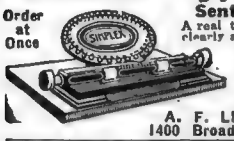

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This Fire Alarm "Talks"

(*Continued from page* 1264)

separates, resulting in the weight being released. This immediately lifts up the hook on the telephone and allows the phonograph to start its call, which has been previously inscribed on records adapted for this purpose. The record is also fitted with a very simple mechanism which causes it to be repeated many times over and either stops its action because the motor is run down, or else that the fire has dangerously neared the fireproof box of the apparatus, when the link outside the cabinet fuses and separates; the telephone hook then drops down into its normal non-operating position. In the electrical system for operating the announcer an idea equally clever has been utilized. Regular thermostats are placed thruout the building so that a rising temperature of 130 degrees will affect the closing of their contacts. In this way a magnetic device very similar to a telegraph sounder, having a tooth filed in the beam, would be drawn toward the magnets. Into this "V"-shaped tooth or notch is fitted a two-pronged hinge so that it is free to drop downward when the circuit is closed.

A steel ball is attached to the cord holding the weight up. This cord is now past thru the opening between the prongs so that the ball rests nearer the hinged portion, and thus very little weight is applied directly to the beam of the sounder. The instant the armature is drawn toward the magnets, the pronged fork is released and drops downward, due to the slight weight upon it. Immediately the pole is free to slide from between the forked lever and the weight coming downward with a sudden thud releases the phonograph and raises the telephone receiver hook.

When the link on top of the box fuses, the weight drops harmlessly to the bottom, releasing at the same time the hook which it had previously held suspended, causing the phonograph to stop.

The phonograph can at any time be removed from the cabinet and used for pleasure purposes and no connections whatsoever are made to the telephone, except for the string which is caught around the receiver hook.

"Rabbit Contest" Awards

(*Continued from page* 1269)

SIXTH HONORABLE MENTION

The phenomenon of the film of the rabbit electrified to 500,000 volts, shown on page 798 of Dec. 1919 issue, may be explained as follows:

Motion picture films are taken at about the rate of sixteen exposures per second. Each exposure I presume lasts about 1/100 of a second or perhaps a little more. The streamers or flashes from the rabbit do not occur at every cycle of the 200,000-cycle high frequency current. The rabbit acts as a capacity and holds the charge for an instant. When the rabbit is fully charged, the charge escapes into the air in the form of streamers and corona. The duration of the charge was not too short to allow more than one discharge to occur during the time of exposure, but too fast for the eye to perceive. The first five pictures of the portion of film shown were taken just before or after the full discharge, hence showing the streamers leaking out. At the sixth exposure, a full discharge took place at the instant. The last two pictures were exposed just at the time when the charge was being accumulated by the capacity of the rabbit right after a full discharge had taken place.

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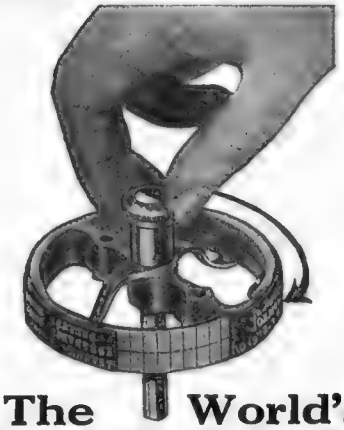

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Automatic Type Impression
All on one MULTIPLEX

The marvelous, INSTANTLY *interchangeable type feature* is only one of the 16 reasons why thousands of prominent men and women in all walks of life prefer *and personally* use the Multiplex.

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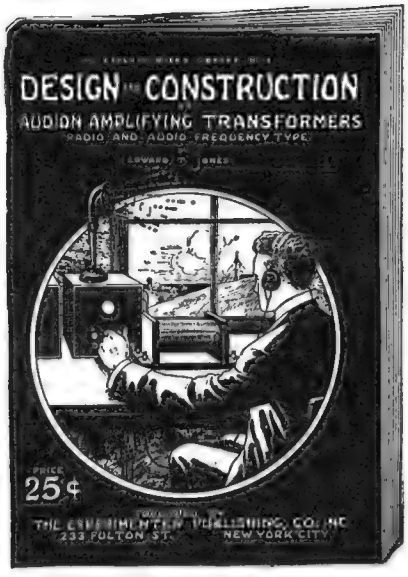

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Watching Plants Grow

(*Continued from page* 1247)

This outflow of water is roughly adjusted by opening the stop-cock to a greater or lesser extent. The finer adjustment is then effected by the suitable variation of the difference of level in the two limbs of the syphon. One end is connected with a flexible india-rubber tube, which is attached to a string passing over a pulley, and fixt to the adjustable wheel B, attached to the observer's table. Rotation of the wheel in one direction will depress this end of the syphon, so increasing the flow, and in the other direction will raise it, diminishing it.

The rate of descent of the float is thus regulated with the utmost nicety, till an absolute balance is obtained. The observer recognizes the condition of the balance when there is no drifting of the spot of light on the recording-drum. The adjusting wheel is now fixt at this position of balance. If any agent should induce an acceleration of growth, the balance is disturbed, and the spot of light moves, say, to the right, or in a *positive* direction. Any agent which induces retardation will, on the other hand, cause a deflection of the spot of light in a *negative* direction.

The record is made in the usual manner on a revolving drum. Our figure illustrates the complete apparatus, which enables us to obtain a record under *balanced* —or by closing the stop-cock of the syphon, also under *unbalanced*—conditions. The wheel is graduated, and the absolute value of the compensatory movement, at any position of the circular scale, can be previously calibrated, by fixing the plant mirror, and observing the extent of movement of the spot of light on the drum, due to the subsidence of the float in a given time.

CONNECT "A A" to your detector or amplifier, and "B B" to a 6-volt battery

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Electrifying Canal Boats and Barges

By ROBERT G. SKERRETT

(*Continued from page* 1262)

ble of energizing the otherwise powerless boats. The latter would have the space now occupied by boilers and engines to utilize for revenue, devoting it either to the carriage of more cargo or a greater number of passengers, and would not be hampered or made dirty by frequent fueling. The prime movers, on the other hand, could go direct to the coaling pockets or the fuel-oil tanks and, being designed purely for motive purposes, grime and smoke would not entail the same property injuries. Finally, this separation of the steam plant from the freight or express vessel would measurably reduce fire hazards and lead to the lowering of insurance rates.

But probably the most conspicuous gain would be in shortening the lay-over periods. That is to say, the power steamer would be kept well-nigh continuously on the job; moving one ship by day and starting back shortly afterwards with another during the hours of darkness. Thus a single central plant would be able to take care of two "trailer vessels" upon a twenty-four-hour schedule. Fantastic as such a project may appear offhand, still a little analysis shows how thoroly rational the scheme really is. In effect it amounts to nothing more radical than applying afloat principles and practises that have become commonplace in the operating of electrified railways and the running of multiple-unit trains.

And now the reader will ask, what has Mr. Donnelly done both to satisfy himself and to convince others that there are not insuperable obstacles in the path of putting his system of distributive propulsion into effect? To begin with, a little over four years ago he built and operated his yacht, the *Dawn,* a craft 50 feet overall of 12 feet beam and drawing close to 4 feet of water when laden. By way of power plant he installed a prime mover in the form of a 60-horsepower gasoline engine, and this he connected directly with a 40-kilowatt electric generator working at 450 revolutions a minute. To drive the *Dawn* he provided a 20-horsepower motor directly connected to the propeller shaft, and this, when making 450 turns a minute, sufficed to give the boat a speed of 9 miles an hour. It will be observed that the generator was capable of furnishing more than double the current needed to energize the motor for the yacht's screw.

Last summer another yacht, the *New Era,* modeled and dimensioned like the *Dawn,* was constructed and equipt with a 20-horsepower motor for the little vessel's propulsion and arrangements were made by which the needful electricity could be supplied from the *Dawn* to insure a speed of 9 miles an hour. The conducting cable is led from a reel over an elevated pulley at the bow of the *Dawn* and thence thru the water to the stern of the *New Era,* where it is linked with the latter's operating circuit. This cable is less than an inch in diameter, and trails with a very modest pull astern of the *New Era,* looping easily and smoothly between the boats when they are maneuvering.

The *New Era* is provided with a number of storage batteries from which "juice" is drawn for lighting and cooking service when the yachts are at anchor. At one time during a trial run from New York City to Schenectady and return something went wrong with the *Dawn's* gasoline engine, which called for the machine's stoppage. However, the boats went right on—both of them obtaining, for the time being, their motive energy from the storage batteries of the *New Era.* The normally de-

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The success of Chiropractors in many cases has come so quickly as to be almost startling. And yet, it is not to be wondered at when you consider the constantly increasing number of intelligent, thinking people who are now convinced that Chiropractic is the common-sense and really scientific way to relieve pain and disease and who, therefore, demand the services of Chiropractors.

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The Physiophone

By H. GERNSBACK.

(*Continued from page* 1253)

does. They have not the slightest conception of perspective and will invariably put the hands out before the eyes in order to judge the distance. The far away mountain will look to them just as near as a wall three feet away, and it is only gradually that a previously blind person learns to judge the distance, i. e., by experience.

The same is the case with the deaf person and physiological music. He must first learn the rhythm of the music, and after a

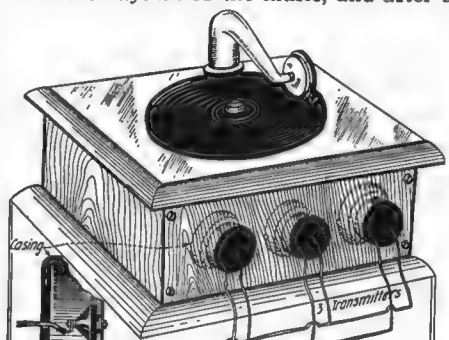

Fig. 1. Experiment to Transmit Sound Impulses Into Electrical Impulses. This Scheme Works Very Well to Transmit Music.

while it will become easy for him to understand what the music or even the human voice is like if introduced to him by means of the Physiophone.

I even go further and predict that sooner or later a totally deaf person will carry around with him an apparatus along the line of the "deaf-phone" type, the apparatus consisting of a sensitive microphone such as is used with the deaf-phones now. The microphone will be in series with a portable battery and telephone coil, while the secondaries of this coil will go to metallic wrist bands of the wearer. Then when he is spoken to he will soon be able to understand the meanings of the small electrical shocks which are the result of the human voice impinging upon the sensitive microphone.

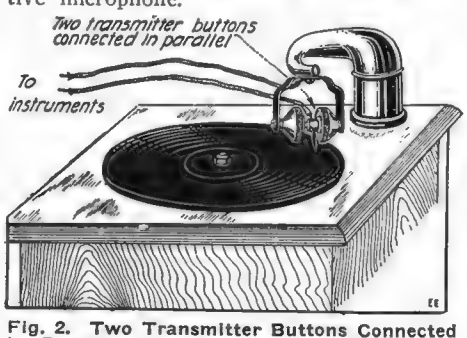

Fig. 2. Two Transmitter Buttons Connected in Parallel, Attached to Phonograph Arm. This Scheme Works Fairly Well For Transmission of Music, But Not so Well in Connection With the "Physiophone."

Coming back to our phonograph experiments, the deaf person can now enjoy dancing which he certainly could not do before, for he had no music or rhythm to dance by. One of our illustrations shows how deaf persons will now be able to dance by means of phonograph music and the Physiophone. The revolving wheel below the ceiling in the room or dance hall has flexible wires hanging down, which in turn connect with the secondaries of the telephone coils. These are connected with the microphone and battery near the phonograph in the manner stated above. Wires hanging down from this wheel connect to metal wrist pieces attached to each one of

(*Continued on page* 1322)

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SPECIAL NOTICE!

Of late we have received so many letters from our correspondents regarding patent advice, that it has been quite impossible to publish all of them.

Altho printed in the smallest type possible, we cannot accommodate more than ten or twelve answers a month. At the present time we are about four months behind. Of course, if our correspondents have time, no harm is done! We would however, advise that if a quicker answer is wanted, correspondents should avail themselves of our special service, as per the notice printed at the head of this column.

All letters are answered in turn as they come into this office, and for this reason it will be understood why it takes so long for an answer to be publisht. Will correspondents please bear this in mind?—EDITOR.

Printing Stamp.

(No. 380) Russell Fletchie of St. Louis, Mo., says as follows:

"I have an idea on which I would like to ask your advice.

"It is a rubber stamp working like a date stamp now greatly in use, but instead of the numerals running from 1 to 9-0, it has the alphabet upon each rotating line or rubber belt. This stamp could be made as wide as wished or as narrow by manufacturers. Instead of stamping dates it would be used to stamp words (any words). I think this would be a great deal better than the small printing outfits now sold in department and 10c stores."

A. This is a good idea, but is neither new nor very practical. It would be all right for somebody who had a tremendous amount of time to spare, otherwise it would be impractical. Take for instance, if you would wish to spell out the word *"extraordinary."* This would mean that you would require *thirteen* bands, and the average word having seven or eight letters, the amount of bands to manipulate would be very tedious, and we do not think that people would wish to bother with it.

Electro-Magnetic Brake.

(381) Ralph E. Hast, Elkins, W. Va., submits the following:

"A number of powerful electro-magnets are placed along the under frame of the cars directly above the rails, and very close to the rails. An automatic coupling socket is at the end of each car so that when the cars are coupled a circuit is completed. The amount of current used is determined by the number of cars, and is controlled by a rheostatic switch within the cab of the engine. The current is supplied by one or more generators in the engine, used in connection with storage batteries. The electro-magnets would be connected in series.

"This method of breaking would prevent the 'flat wheels' resulting from the present form of 'air brake' as the wheels would continue to revolve until the train came to a standstill.

"As additional cars are added to the train, more current is used when braking. This braking would also, I think, be more easily controlled.

"Of course the proximity of the electro-magnets to the rails would have to be determined by the average weight and speed of the cars."

A. There have been many patents taken on electro-magnetic brakes in the past, but for some reason they have not proved very successful, as none of them have been adopted to the best of our knowledge. It seems that electro-magnetic brakes do not stop the train very much quicker than an ordinary brake does. It should always be borne in mind that a train is heavy enough to brake itself once the ordinary brakes have been applied and the wheels grind along the rails. Any additional tractive effort on the rails would not be worth while expending extra energy. Besides in order to energize these electro-magnets, an extra current supply would be necessary, which is not always available on all trains.

Snow Melter.

(382) Hugh Reynolds, Brooklyn, N. Y., writes us:

"I have been very much astonished that New York was unable to run its street cars for weeks at a time because of the recent snow storm. I have personally examined the third rail slot and I convinced myself that in some cases ice covered all of them as high as one foot. It occurred to me that it should be possible for the traction companies to place an electrically heated boiler on a specially designed car and then generate steam. Three jets of steam would be expelled in front of the car, one for each rail and one for the trolley slot. With this steam it seems to me that it would be only a matter of a few hours to thaw out the railroad. Of course, where the snow and ice was over one foot thick the progress of the steam car melting its way thru the snow and ice would be naturally slow, perhaps only a few feet per hour. But, the main point is that in a day a vast stretch would thus be melted out. I would like to know why a scheme such as this is not practical? If so, please give me the reasons. If you think it is practical, could I obtain a patent on it?"

A. It seems that we have read of a similar scheme that had been tried before, somewhere in the West, but we believe it was not very successful. While it is possible to use a device of this kind, we think the main trouble lies in the fact that it is difficult to keep up sufficient steam by means of electrical power, because the amount of steam which would be required to do the thawing would be quite prodigious. Furthermore, it would not be practical just to thaw away the ice and snow *only* where it covered slot as well as the rails, because if the snow were deep enough the cars could not proceed unless *all* of the snow and ice had been melted on the roadbed, and this probably would require too much power. This is one of the reasons why we believe the scheme would not prove practical.

Patents and Citizenship.

(383) Max Kroner, Detroit, Mich., seeks our advice.

"I wish to apply for a patent in the United States, but I am not a citizen of this country, having been born in Denmark. Can I apply for a patent, and will the United States Patent Office grant me a patent if I do apply?"

A. Yes. You can apply for a patent, and the United States Government will issue the patent to you. You will, however, have to state of what country you are a citizen in your application. You do not have to be a citizen of the United States to obtain a patent.

"Interference."

(384) Pierre Bordeaux of Los Angeles, Calif., writes to us:

"If I applied for a patent and another man has also applied for a patent at the same time on

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a similar device, who will get the patent? How does the Patent Office discriminate in such cases?"

A. This is technically termed "interference." In other words, when two inventors apply simultaneously for a patent as a rule the Patent Office throws the case out and the two inventors will have to revert to litigation.

The Physiophone

(*Continued from page 1320*)

the dancers. As soon as the music starts, the dancers become conscious of the music and begin to dance, enjoying the dancing, perhaps, even more than normal human beings, due to the electrifying effect of the current. As the dancers progress, the overhead wheel keeps turning so that the wires do not become entangled.

As for the normal human being he can also enjoy the physiological effect of the electrical current for the principal reason that Faradization is healthy and invigorating and entirely harmless. Another one of our illustrations shows what can be accomplisht along these lines for the normal

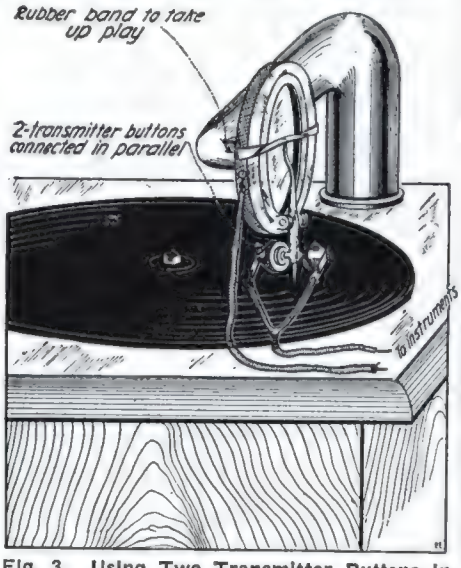

Fig. 3. Using Two Transmitter Buttons In Parallel. Note Feathering Arrangement.

human being. Picture a concert hall, along the stage of which a battery of sensitive microphones is located. The current is led to the primary of a large induction coil in series with the battery. Secondary leads go to metallic handles hung at the back of each orchestra chair thruout the theatre. As soon as the music starts, every one in the audience can grasp the handles, and they will now experience the novel effect of *not only hearing the music but also feeling it in a very invigorating manner.* This thing has already been tried out by the writer in a small way. It is perfectly possible to put your body in series with a loud-talker telephone. Of course, the music coming out of the horn will now be weakened, but if your hands are wet or moist, the weakening of the loud-talker music is not too great. You are now enabled to *hear* the music as well as *feel it.* It will be noted in one of the photographs that a rheostat is used, which is quite necessary to reduce the current. Some phonograph records as for instance band music are so loud and act so powerfully upon the microphone diafram that it is quite impossible to hold onto the handles comfortably. It should be noted that on some phonograph records not all the sounds can be transmitted. In other words, very high sounds do not make themselves felt at all, and some such records as the flute or other soft musical instruments do not lend themselves well for physiological effects. Records containing xylophone, piccolo, band music and the ones with singing voices are probably the best.

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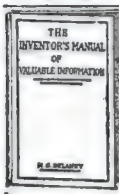

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The Electrical Machinist

(*Continued from page* 1278)

at Fig. 3-B. In leveling medium and large size dynamo and electric machinery, recourse is often had to the methods shown at Figs. 3-C and D. At Fig. 3-C a leveling trammel or bar is used, and this is placed across the two machined surfaces on front and rear of the motor or dynamo base.

As these are accurately machined and in perfect alignment with the two bearings of the machine, this invariably gives accurate results. However, this gives the alignment of the machine but in one position only, and it must also be leveled in a crosswise direction by placing the leveling trammel or bar across the machined surfaces where the field frame is secured.

The scheme of leveling shown at Fig. 3-D implies a taut cord or else a piece of shaft which may be past thru the two bearings of the motor frame. The frame is then leveled until the shaft shows it is at the correct point or else the frame is leveled until the bearings measure with equal spacing around the center cord or string. In this case also the base must be leveled in a crosswise direction, as at X, by placing a leveling board or bar across the two machined surfaces where the field frame will later rest.

SECURING MOTORS IN PLACE.

Small and medium-sized dynamos and motors are frequently secured in position after they have once been aligned with the shafting or other machinery which they are to drive, by means of lag bolts. A lag bolt is, in reality, a glorified wood screw, and it resembles a bolt at one end and a wood screw at the other, this end being brought to a point so that it can be driven into wood and then turned with a monkey wrench, which will cause it to thread its way into the wood the same as any ordinary screw.

At Fig. 4-A a motor is shown fastened to a wooden ceiling. It is usual to place two pieces of wooden joist across the feet of the motor as shown at A, and these joists are *lagged* to the wooden floor beams. The heads of the lag bolts should be countersunk down into the wood so that the surface of the joists present a perfectly level plane. Then the motor is blocked or held in position, and the feet of same are secured to the small cross-joists by the lag bolts. It is usually necessary to prevent splitting the wood with large lag bolts, to drill a small hole before they are started with the hammer and then turned with the monkey wrench.

At Fig. 4-B another method of motor installation is shown. The floor beams under which the motor is here secured may be of wood or concrete.

Cotter pins passing thru small holes drilled thru the ends of the bolts are best used, but some motor concerns who supply bolts for this purpose provide self-locking nuts, or else cut spring-lock washers, which are placed behind the nuts so that when these are tightened up against the washers, the spring in the washers will exert pressure against the nuts, and thus prevent them from being shaken or vibrated loose.

At Fig. 4-C one scheme for mounting a motor on a concrete floor is detailed. The motor is mounted on two wood stringers made of two pieces of joist placed under the feet of the motor. These joists are countersunk for lag bolts, which are threaded down into expansion sleeves placed in suitable holes drilled for them in the concrete. The motor is later placed on these wooden stringers and secured by suitable size lag bolts threaded down into the wooden joists.

(*This series to be continued.*)

The toolmaker says:

"Yes, I've got quite a number. No more, probably, than most toolmakers, but quite a number just the same. But then, I ought to have a lot of 'em. I've been buying Starrett Tools ever since I was an apprentice.

"You know my work calls for pretty close limits, and some way or other I've got a feeling of confidence in Starrett Tools that makes it easier for me to do good work.

"When did I get my first Starrett Tool? Oh, somewhere back in the 80's. In fact, it must have been pretty soon after the Starrett factory started. There's one thing that always impressed me. Right from the start, Starrett Tools have been designed and made by men who knew machine shop practice You know, practical men. And somehow it shows in the quality of the tools."

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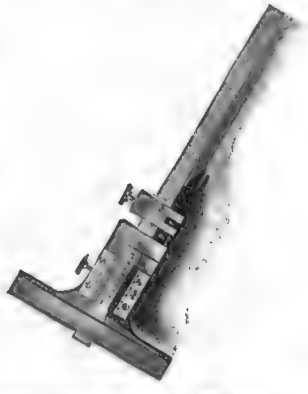

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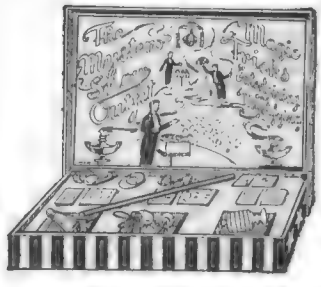

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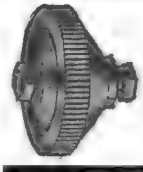

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The "Finer Workings" of Static Electricity

By FREDERICK VON LICHTENOW

(*Continued from page* 1275)

However, as I have stated before, *induction* takes place first, and that is what we have here to do with. Then follows attraction. After the short while occupied by neutralization of their "in-between" charges, the light objects retain only their induced "outer" charges (naturally opposite to those of their respective sources!) and upon separation fly, "stronger than ever" over to these and make contact with them (See Fig. 7-a).

The behavior of the balls during neutralization evidences in this as well as in experiment No. 4, Part 1, very graphically what I have said in reference to their properties as conductors and insulators. They are a mixture of both; they are the "Guinea pigs" of the electrostatic-research worker, for they respond to anything belonging in that sphere.

Whenever an object susceptible to an electrostatic charge is subjected to the neutralizing process while under the influence of an inductive (outside) force, such object will invariably become charged (in this case oppositely!) to the extent of holding the charge for a given period. In other words: if neutralization is followed *instantly* by induction, a charge will be effected without the usual resort to contact (with the charging body!). This is clearly demonstrated by the action of the gold leaves of an electroscope, when the latter is inductively charged. The *neutralizing process* is *the magic factor,* which makes this possible and, to emphasize again, it must take place "just ahead" of (almost simultaneously with!) the inductive action. This magic factor was made use of by the author in the successful workout of Experiments Nos. 3 and 4, of Part 1.

(*To be continued*)

Measuring Electric Current with the Eye

By C. A. BRIGGS

(*Continued from page* 1276)

the figure, by means of a potentiometer connected by leads to a standard resistance interposed in the circuit.

In using the device the current to be measured is past thru the bulb nearest the eyepiece and the current in the other bulb is varied until the observer sees that the filament at one point disappears against its background, on account of the intensities being matched. From the value of the current past thru the bulb at the closed end, as shown by the potentiometer, can be determined the current passing thru the other bulb.

A temporary set-up of an instrument of this character showed that very good results can be obtained. This accuracy is in part due to the fact that under ordinary circumstances a small change in the currents heating either filament will produce a proportionally greater change in the intensity of the illumination. It was found that by this arrangement the value of an electric current could be established to within an accuracy of two parts in a thousand; and with further development it is very probable that the accuracy could be increased. Before use this apparatus is calibrated against direct current instruments.

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are feared by all fire fighters. Water or ordinary chemicals are dangerous to use and have no effect on fire. A

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to Manufacturers
Importers
Dealers
Jobbers
Agents
Amateurs
Purchasers
Users of

Vacuum Tubes

The Marconi V. T. Patent is Basic

United States Letters Patent to Fleming, No. 803,684, November 7, 1905, has been held to be valid by Judge Mayer of the United States District Court for the Southern District of New York, and by the United States Circuit Court of Appeals for the Second Circuit.

It is a basic patent and controls broadly all vacuum tubes used as detectors, amplifiers or oscillions in radio work.

No one is authorized to make, sell, import or use such tubes for radio purposes, other than the owners of the patent and licensees thereunder. Any others making, selling, importing or using them alone or in combination with other devices, infringe upon the Fleming patent and are liable to a suit for injunction, damages and profits. And they will be prosecuted.

THE AUDIOTRON AND THE LIBERTY VALVE ARE NOT LICENSED UNDER THE FLEMING PATENT

The price of the genuine Marconi V. T. delivered is $7.00 each. The standardized socket is $1.50 additional. The standard resistance, complete, costs $1.00 and is made in the following sizes: ½ megohm, 1 megohm, 2 megohms, 4 megohms, 6 megohms.

Do not take chances by making, importing, selling, purchasing or using vacuum tubes for radio purposes not licensed under the Fleming patent. By selling, purchasing or using licensed tubes for radio purposes you secure protection under the Fleming patent and avoid the risk of litigation for infringement thereof.

This warning is given so that the trade and public may know the facts and be governed accordingly.

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2000 OHM SET.....$4.50
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That these Murdock No. 55 Sets have earned a nation-wide reputation for value, is due, not so much to the fact that they are, without question, the best low priced receivers obtainable anywhere, as it is to the recognized fact that they closely approximate in operation the sensitive performance of the most expensive sets.

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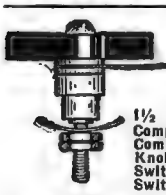
If you want to become an Expert Wireman Read page 1235



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1½ In. Radius	Postpaid Price
Complete Switch, polished brass finish	50c
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THE WILCOX LABORATORIES, Lansing, Mich.

Advertising Talks

NUMBER 6

(*Continued from page* 1296)

our columns clean and allow only reliable firms to use them. And if there are any readers who have not understood the point you bring up I hope they will read this letter carefully and write me if they feel they have not been justly treated in any transaction.

On the other hand, I do think that manufacturers should publish the shipping weight of all articles which they do not ship prepaid. Many of them do, but to those who don't I want to recommend it now, right here, and I hope that all who read this will think it over and follow the suggestion.

Write again, Mr. Reed.

Very cordially yours,

R. H. Morse

Advertising Manager.

Some Long Distance Radio Telephone Tests

By ROBERT F. GOWEN

(*Continued from page* 1281)

reporting good reception when using only one receiving tube.

While continuing tests with Mr. Charles Candler at St. Mary's, Ohio, the signals and speech were picked up by Mr. R. H. G. Matthews, Chief Engineer of the Chicago Radio Laboratory at his Chicago Station. He reported that the speech could be heard plainly at a distance of over 10 feet from the telephone, altho the buzzer on the modulated wave was slightly louder. The power imput for these tests was 285 watts.

A continuance of tests with Mr. Matthews during the last week in January, brought in reports from Little Rock, Arkansas, and from Valley City, North Dakota, distances of about 1200 and 1500 miles respectively. Mr. Clayton at Little Rock reported the speech particularly understandable, but Mr. Pray at Valley City, North Dakota, stated that the speech was weak, but that he was using a very inefficient receiving set. In February, the speech was successfully heard and copied at Baudette, Minnesota, which is nearly as far away as Valley City, and many letters have been received from St. Paul, St. Louis, Minneapolis, and many cities in Michigan to the same effect. In the latter instances, however, the imput was increased to 510 watts and in one or two cases the tests were made on a prearranged schedule.

In practically every instance the reports were most enthusiastic as to the modulation or clearness of the speech. Whole spoken sentences were quoted and some even went so far as to comment upon the accent of the person talking. The reports unanimously indicated that once the receiving station found the tune of the transmitted wave, there was no difficulty in hearing the speech clearly and loudly. Mr. Candler at St. Mary's reported one night that he could not use his two steps of amplification as it hurt his ears. He telegraphed back that the writer's voice fairly screamed at him.

The experiments have shown that with a remarkably small power imput, stations practically half way across the United States can be reached even when the set is operating very inefficiently on an aerial and on wave-lengths for which it is not designed.

The tests are being continued at eleven o'clock nightly and the writer would be pleased to hear from those who are interested as to their results in receiving him at some distance.

Super-Sensitive Microphone ONLY $8.00

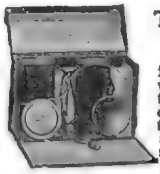
This instrument is offered at an extremely low price. It is excellent for building your own amplifier. Can also be used in many experiments where a sensitive microphone is required.

Detectagraph, $18.00

This detecting instrument of marvelous sensitivity can be used for detecting secret conversations. Outfit consists of Sensitive Transmitter, 25-ft. Black Cord, Receiver, Headband, Case and Battery.

Send for One To-day and Convince Yourself

Detectagraph $18.00



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is a super-sensitive instrument which has been developed to meet the demands for a practical and efficient hearing device at an extremely low price. It is equal to any $35 instrument made and superior to most of them. The outfit consists of One Super-Sensitive Transmitter with cord connector; One Super-Sensitive Ear Piece with small black cord; One Black Single Headband; Black Case and Two Batteries.

Adjusted Model "B" Horn, with No. 20 High Grade Loud Talking Receiver, Cord Plugs and Desk Stand Base. Price, $12.00 Complete.

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Makers of Super-Sensitive Microphone Apparatus

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You can find out with "Ace" equipment.

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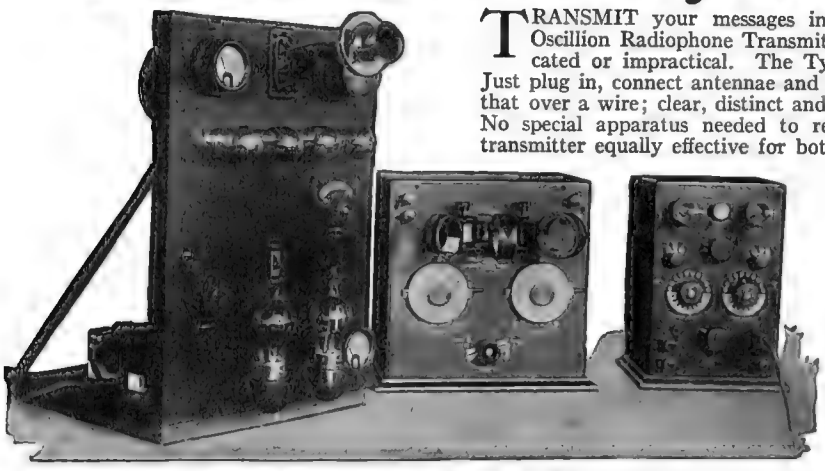

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Type "O," "A C," Oscillion Transmitter for Radio Telephone and Telegraph (left); Type T-200 Multiwave Tuner (center), and Type P-300 Combination Audion-Ultraudion Detector and One-Step Amplifier (right). This outfit comprises a complete Radio Telephone-Telegraph Station for both transmission and reception. The instruments may be purchased separately. Send for a catalogue and get complete details.

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With Shunt Resistance—
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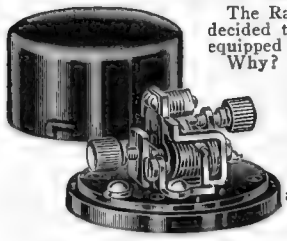

The Radio Officers of the NC Planes, after testing all other buzzers, decided to use the "Mesco" on their radio equipment. The R-34 was equipped with two Mesco Radio Buzzers.

Why? Because of its reliability and constancy in operation; greater output efficiency; ease of adjustment; unaffected by extreme variations in weather conditions; exposed wires eliminated.

Sparking is almost entirely eliminated, so that the energy lost in light and heat in the operation of other buzzers is here conserved and radiated in the form of oscillating energy.

This buzzer maintains a constant note and is recommended as an exciter for checking wavemeters where pure note and ample energy are required.

List No. 55, Mesco Radio Buzzers. Price $2.05.

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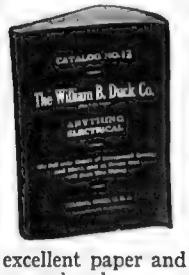

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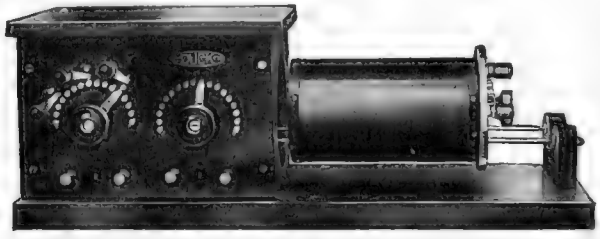
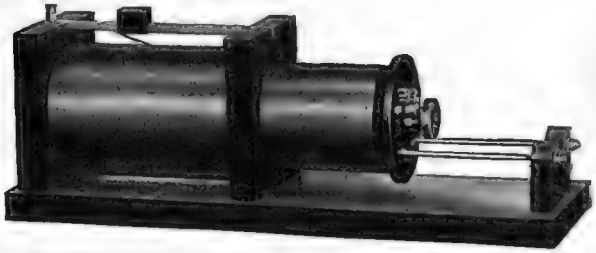
The wireless catalog mailed for 12c and the electrical catalog for 6c, either in stamps or coin, which amount you are privileged to deduct on your first order of $1.00. Catalog positively not sent otherwise. This edition of our wireless catalog is the most complete and elaborate we have ever put out. It embraces everything in wireless worth while. As an enclyclopedia of information it is invaluable. It is printed on excellent paper and with a beautiful cover. Your amateur friend will tell you that there never has been any wireless catalog to take the place of Duck's, and above all, that you can absolutely rely on the quality of every instrument listed in this catalog. In a word it is all worth while catalogs in one.



A big improvement over our former model. Primary divided into four sections, with three dead end switches, greatly improving selectivity. Secondary divided into three sections, with two dead end switches, eliminating harmonics. The change in the construction of the guide rod support makes it possible to obtain a looser coupling. It is a wonderful improvement over our old model both in performance and appearance. Only $23.50.

NEW MODEL 5BB, NAVY TYPE RECEIVING TRANSFORMER



The secondary on our new type Arlington is divided into three sections with two dead end switches eliminating dead end effect and harmonics and giving greater selectivity. The end support is similar to that on our Navy type permitting a looser coupling. It is a beautifully finished instrument.

Price only $12.50

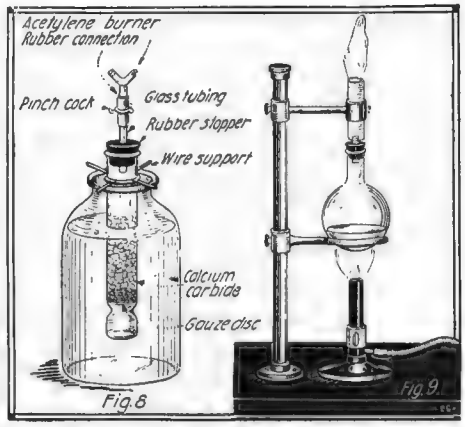
OUR IMPROVED ARLINGTON RECEIVING TRANSFORMER

THE WILLIAM B. DUCK CO., 230-232 Superior St., Toledo, Ohio

Practical Chemical Experiments

By PROF. FLOYD L. DARROW

(*Continued from page 127*)



Here You Are, Boys. Make Your Own Gas Light for Your Lab.

A Gas Formed by Boiling Borax, Sulfuric Acid and Alcohol Gives a Beautiful Green Flame When Ignited.

Put the apparatus together as shown in figure 8. Then fill the chimney two-thirds full of lumps of calcium carbid and pour water into the bottle. Open the pinch cock and the water will rise thru the disc and coming in contact with the carbid will generate the acetylene, which in a few moments may be lighted at the burner.

PRODUCING A GREEN FLAME

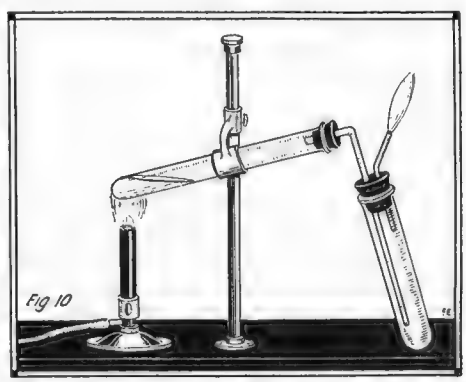
In a small flask place a mixture of 3 grams of borax, 3 c.c. of concentrated sulfuric acid and 20 c.c. of alcohol. In the neck of the flask insert a stopper and short length of glass tubing. Over this, as shown in figure 9, mount a short length of medium sized combustion tubing. Boil the mixture and light the vapor issuing from the top of the large tube. The result will be a brilliant green flame.

GENERATING COAL GAS.

Arrange apparatus as shown in figure 10, placing in the hard glass test tube some pulverized soft coal. Heat the tube strongly with a Bunsen burner flame and presently a gas will be given off which may be lighted at the end of the delivery tube, where it will burn with a luminous smoky flame.

In the condensing tube will be found a tarry distillate, which is commercially known as coal tar and is the source of a host of organic compounds.

In the hard glass tube will be left a steel gray residue of coke.



Even Coal Gas Generation Is Not Exempt, Provided You Have Two Test Tubes, a Burner and Some Sort of a Stand to Hold the Same. The Gas Coming From the Small Tip in the End of the Terminal Test Tube Can Be Ignited and Will Be Seen to Burn With a Luminous Flame.

"ASK ANYONE WHO HAS USED IT"

WHAT OUR PATRONS SAY

"I can hear the signals three times as loud and clear as I could with my old receivers." (Name on request.)

BRANDES WIRELESS HEADSETS

CLEAR TONE LIGHT WEIGHT
DEPENDABLE SERVICE

Score 100% efficiency in actual use. Sharp, Unblurred, Readable Signals assured by

"Superior" Set, 2000 ohms, $7

"BRANDES MATCHED TONE"

Exactly matching the tone of both receivers in each set and thus eliminating all confusion due to unmatched harmonics.

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PREPARATION OF WATER GAS.

Water gas is one of the most important fuel and illuminating gases and may be prepared as follows:

Set up apparatus as shown in figure 11, using a hard glass combustion tube 18 inches long and ¾ of an inch in diameter. In the end of the tube next to the flask of boiling water insert a roll of previously ignited asbestos paper, into which the tube from the boiling flask should lead. The asbestos is to prevent the breaking of the tube from the condensation of steam. In the combustion tube place lumps of charcoal and heat them to redness with a 4-tube burner. Then boil water in the flask and pass the steam over the glowing charcoal.

REFINING CRUDE PETROLEUM

Arrange a distilling flask and condenser exactly as they were for the distillation of alcohol, as described in the February issue. *Be sure all connections are tight.*

In the flask place some glass beads and fill it half full of crude petroleum. The thermometer used should be able to register as high as 360° C. Having provided a wet towel to smother the flames in case of accident, begin heating the flask. Notice that the petroleum very soon begins to boil. Catch the distillate in a small dry flask and when the temperature has risen to 70° C., replace it with another flask. Continue the distillation changing the receiving flask at 80° C., 120° C. and 150° C. stopping when 300° C. has been reached. This will give five fractions and a thick tarry residue in the flask.

The products are practically the same as the petroleum products sold on the market:

Petroleum ether
Light gasoline
Heavy gasoline
Naptha
Kerosene
Lubricating oils, Vaseline, Parafine } Obtained from the residue in the flask.

Pour the residue from the flask while it is still hot and rinse the flask with gasoline.

FLASHING POINT OF KEROSENE

A sure index to the grade and safety of kerosene is its "flashing point." This is the temperature at which the vapor rising from oil will "flash" when a flame is brought near it.

In a tin cup placed over a Bunsen burner pour four tablespoonfuls of kerosene. Try to light it with a match. If it is a good grade of oil you will not succeed. Gently heat the cup and contents and at frequent intervals try to light the vapor, at the same time taking the temperature. The temperature at which the vapor will just ignite is approximately the *flashing point* of the oil. The flashing point of good grades of kerosene is from 120 F. to 140 F. If the oil does not simply flash and go out but continues to burn you have past the flashing point. In that case put out the flame by covering the cup with a glass plate and allow its contents to cool. Every minute or two test with a lighted match. The lowest temperature at which the vapor will just ignite is the *flashing point.*

(The next paper will appear in an early issue.)

ATTENTION!!!

RADIO, ELECTRICAL and CHEMICAL laboratory owners, refer to our monthly laboratory contest on Page No. 1288, for prizes offered for laboratory pictures. We have not received any worth while photos for several months. Now is the time to get busy with that camera and take a photo of your "Lab," and do not forget one of yourself! The more good ones we get, the more we will publish,—so send us some "real Lab" photos by the very next mail, won't you?

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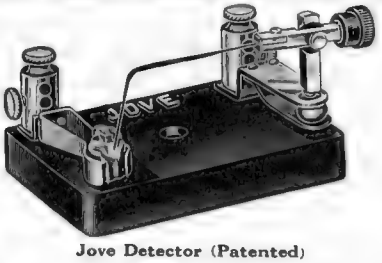

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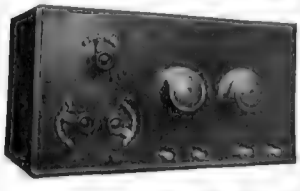

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War Versus Pre-War Apparatus

By "SPARKS", C. E. Radio U. S. N.

(*Continued from page* 1285)

ments are purchased intelligently and carefully, the amateur station can pick up signals from stations many thousand miles distant.

TRANSMITTING APPARATUS.

The prevailing question in Amateur circles in regard to transmitting apparatus seems to be whether or not it will be "arc or spark." Personally, I am firmly convinced that the spark will stay for some time to come. The arc is being widely developed commercially, but so is the spark, and for short wave lengths, the spark has proved the more satisfactory to date. In view of the rapid development of the arc, two or three manufacturers have put an amateur undampt wave transmitter on the market, all of which are excellent sets of their kind. They are capable of doing very good work with the small amount of power which they consume. They may also be used as radio telephones, with a slightly decreased range than when used as telegraph transmitters.

A vacuum tube transmitter is also on the market now, and looks promising, but the choice today lies with the individual Amateur. It will probably mean that a bunch of us will have to install arcs at the same time or let the old spark do the work for a few years longer. She has done so well in the past, and there is still such room for improvement in spark sets that it's a little early to think of undampt waves for two hundred meter work. Let's turn our attention to better results with the spark sets. Develop the non-synchronous rotaries. There is room and then some for improvement there. Get after them and let's see what can be done toward making an ideal spark set. Go after oil condensers, or at least those with reliable insulation. Oscillation transformers should be wound with heavy ribbon and of a width that will count—not quarter inch stuff, or even half. Make one or one and a half inches wide for a one-kilowatt set. Transformers, too, should be of proper design and are often better purchased than made at home. Above all, keep your leads short, and heavy, and get enough turns into your oscillation transformer to chase the energy across. What will a quarter turn in the primary do?—make it one and a half, and cut down your leads elsewhere.

There is a vast field for the development of a good spark coil set. We don't all live in the city where we can have "AC" by turning a switch. Get a spark coil with a good vibrator or substitute some sort of interrupter for the vibrator—they are woefully poor at best. Then see what you can do with it, and if you hit something real good, let us all know about it—don't keep it to yourself. In your spark coil experiments, tho, watch your wave, for the spark coil and little boy are the pests of the "relay game," and no one wants to be clast with them.

Get busy now, and let's see if we can't have some really good stations this season. We had scores before the war, but we want hundreds now. Let's have descriptions and data on the good stations and apparatus so that we may all benefit. I have made receiving outfits such as described herewith, and they have given me wonderful results. Lying in the harbor at Antwerp, Belgium, quite a way inland, I had no trouble in getting Arlington's spark, Tuckerton's alternator and several U. S. arcs, with one bulb. If they prove as satisfactory on short waves as they have proved on the long ones, I'm going to describe them for you fellows. Let's all do that.

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Electricity Foils German Seals

By FRED C. KELLY

(*Continued from page* 1251)

One of the five men had establisht himself as a lookout in a public washroom down the corridor, a few paces from the outer door of the consulate.

It was arranged that if danger should threaten he would walk down the corridor and give two quick taps on the door. On the night mentioned he did hear some one coming up a stairway. Quickly he gave the alarm and then hastened back to his secret post in the lavatory. Then men who had been operating on the filing cases flicked off their electric light, which was a specially arranged one that illuminated only a limited area. They gained hiding places under tables and behind desks barely in time to be out of sight when the watchman, if such it was, opened the door and peered inside. But he was there evidently just as a matter of routine, in the course of his regular rounds, and did not chance to notice anything unusual about the office, tho one of the searchers was lying within four feet of him. After a moment or two he continued on his way.

Every detail of the plan of restoring the safes and filing cases to their usual condition was carefully thought out. One man was even assigned to the job of seeing to it that the dust on the filing cases was about as it had been. He swept up dust from the floor and placed it where finger marks might have showed.

The visits of the five men continued, beginning probably late in April, until the early part of July, and it is believed that in the early morning of the Fourth of July, by way of patriotic coincidence, the last of the German documents were removed from the consulate.

On this final visit the five men arranged to open a section of filing cases and also the steel trunk, which was locked and sealed about as the safes had been. It had been left until the last, because, for some reason, the men had an idea that the papers it contained might be of the least importance. The truth was that the Germans had intended this trunk to contain the most important documents of all.

But when the men succeeded in opening the one remaining section of the filing cases and this steel trunk they had a surprise that left them breathless.

Both the filing case and the steel strong box were already empty!

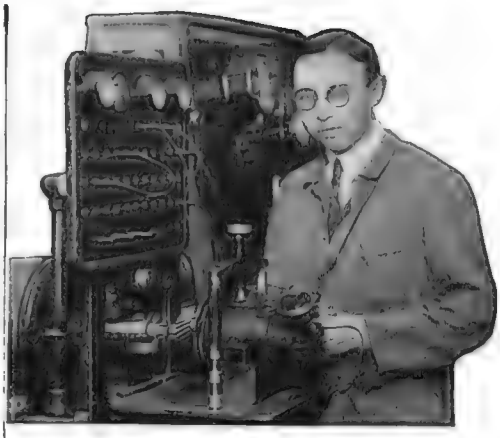
They had been carefully sealed up by the Germans without containing any papers at all. It is now pretty well understood that the papers had been secretly taken away by one of the Germans who was intrusted with the job of storing and sealing them up. Just what personal use he intended to make of them never has been disclosed. They were found by the merest chance, so I have been told, in two large suitcases and a steamer trunk in an obscure storage warehouse some weeks later.

When discovered these papers were promptly turned over to the United States Government. It so happened that they reached the possession of Government officials at about the same time as the other papers taken by the five adventurers from the consular offices.

FIVE ADVENTURERS UNKNOWN.

Thus it came about that the United States Government does not know even to this day how, when or by whom the papers were captured.

Having once obtained the papers, the Government set translators at work on them. The variety of information then acquired was really astounding, for the seized correspondence showed how intricately Germany had allied its industrial with its espionage system.—*New York Tribune.*



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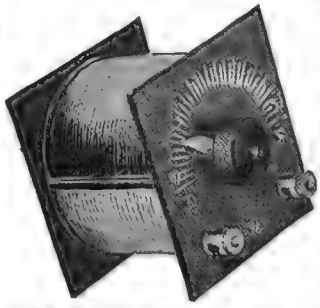

The rotary variable condenser is a necessity for all experimental wireless work and one or two of them are to be found in almost any wireless station. The two most popular types are the 43 plate and 21 plate with capacities of .001 mfd. and .0005 mfd., respectively. The large size has 21 rotary aluminum plates and 22 stationary aluminum plates. The small size has 10 rotary and 11 stationary plates. The ordinary rotary variable condenser is mounted in a cheap round metal case with a cheap composition top and coarse scale. Its plates are 0.15" thick and the shaft is 3/16" in diameter.

The "Tewno" Rotary Variable Condenser has two genuine "Formica" ends, a clear glass case, a ¼" shaft and plates .024" thick of a special grade of aluminum. However, the biggest feature in favor of our condenser is the form of end-piece used. It is square, facing the operator. It is not necessary to look over one's hand to see the scale, as was the case in the old upright type of condenser. The scales on these instruments are calibrated to 2½ degrees.

We recommend our 43 plate condenser for primary and secondary tuning on sets of fair range and for use in oscillating circuits. Our 21 plate condenser is well adapted to short wave tuning for use in small wave meters and a great variety of work calling for a small variable capacity.

Do not be fooled by an instrument that is "just as good." These are to date the best condensers on the amateur market.

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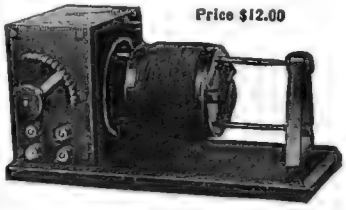

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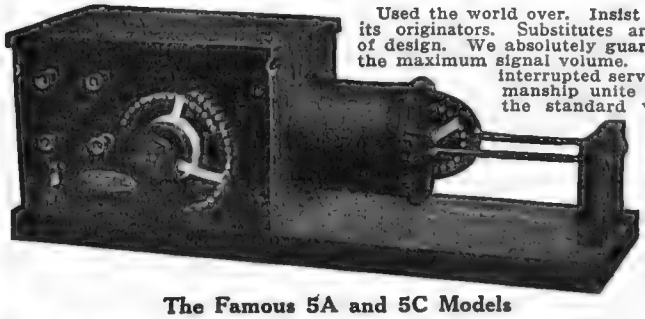

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The Battle Tracer

(*Continued from page* 1242)

tom of which is attached a driving wheel with a perifery of sharp teeth preventing the Tracer from slipping off the table.

When a distant transmitter is actuated, this motor in the Battle Tracer is simultaneously operated, causing the driving wheel underneath the Tracer to move slowly along the table, carrying the Tracer with it. The distance traverst in this way is exactly proportional to the actual distance traverst by the ship itself.

Lines of perforations are made by the teeth of the driving wheel to trace the course of our own vessel. The inner dial likewise is made to turn by a third motor, and the picture of the ship engraved upon it will show the direction in which our vessel is traveling. In other words, the engraved outline of the ship on the movable dial is kept in plane with the rotation of the driving wheel carrying the Battle Tracer along the table.

The pointer (D) heretofore described going to the outer surface of the movable dial and the inner surface of the fixt dial indicates on the outer dial (A) the true compass bearing of the target, and when read with reference to the inner dial (B) indicates the true bearing of the target with respect to the ship.

A second pointer (E) controlled by another electric motor passes to the smallest of the three dials and gives a reading of the speed of our own ship transmitted, as has been stated, on the revolution converter.

The enemy arm is continually being moved in accordance with the range, coming from the target bearing transmitter. On this arm is located a small carriage having two pencil points, and traveling on tiny rollers. The distance of this carriage to the center of the Tracer is directly proportional to the range of the target. This distance is regulated by a fourth motor, actuated by the auxiliary range transmitter. On the big gun turrets of the battleship are the *range-finding* instruments. These instruments consist of an arm 30 feet long with mirrors and lenses at each end; one is set at a 90 degree angle and is moved until the operator's eye, looking thru a hole near the center of the instrument, spots the enemy. Immediately he attempts to twist the other end mirror so that the enemy may be observed at the same time. The angle thus formed allows the computation of the range. The range thus determined is transmitted to the Tracer room, where an operator turns the Auxiliary Range Transmitter in accordance with the information he receives from the *range-finding* instrument. In this way communication to the Tracer is obtained.

Scales are provided for reading the range directly. Likewise, pencil points operated on the ends of magnets controlled by a clock, produce dots along side of the course. Now, then, let us see what all these results come to. First, we plot automatically by communications directly from the propeller shafts and gyro-compass the course and speed of our ship on a large sheet of paper.

This is one definite factor that is known. Secondly, instruments, on the mast-heads of the vessel, keeping a "line" upon the enemy vessel, cause the enemy arm to trace another course upon the table. See diagram herewith.

All of this is figured out to mathematical accuracy and system of ratios so that if the enemy is eight miles away, the pencil

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line for the enemy will extend out a definite radial distance from the center of the Tracer proper. If the distance between the two ships decreases the course of the both ships will approach each other as clearly noted on the Tracer table chart.

Should at any time one of the instruments lose bearing of the enemy, the operator at that observing station releases a button and no mark is placed upon the Tracer table until he again finds the range. Thus we now have the complete and definite data of the speeds of both ships and the courses they are pursuing.

If we could fire a shot at the instant that we obtain the enemy's position, it would be very easy to put the other vessel out of commission, but it takes time to elevate the guns and make other necessary changes. Hence, a matter of *predicting* range is made use of. Calculating our own ship's position by a very simple adjustment which fits on the Battle Tracer, and knowing that we ourselves are not moving to any appreciable extent, it is simple enough to predetermine exactly what position the other ship may be in, in say one minute from that period.

Accordingly, instruction is sent to the gunners, the guns pointed, and the instant that the ship gets into the position which had been predicted for it, the order to fire sends out a broadside salvo which invariably causes marked destruction of enemy life and property. Strange to say, even the time required by the shells in reaching their intended victim, is allowed for.

The device is worked out to the greatest accuracy, even to a correcting device for tides, winds, ocean currents, etc., and provision is made for the condition of the ship's hull—all automatically.

At the revolution converter is an automatic indicator which corrects the speed of the motors in the Tracer table in accordance with the chart used. These charts can be set to a scale of 1-30,000, 1-40,000, 1-60,000, 1-80,000.

The advantages of Tracer equipment on any vessel regardless of whether the vessel is engaged in war or not, are manifold. Chief among these are the uses that it can be put to in recording accurately a ship's log, plotting at all times the course of the vessel and being of a great advantage in what is known as *dead reckoning*. By this, we mean that a vessel may leave a port during a storm and perhaps two or three days later, may attempt to locate itself, but due to the fact that there is no sun in order that observations may be taken, it does not know its latitude and longitude, simple because it cannot recall how far or how fast it traveled, even tho compass readings have been carefully jotted down hourly. Similarly, in submarine work where a vessel is submerged, probably for days, all that is necessary, is to determine its location, on the day it sailed, and the Tracer will tell you where you are any time you may desire, having already made correction for tides, winds, and vessel conditions. —*Photos Courtesy Sperry Gyroscope Company.*

ATTENTION!!!

RADIO, ELECTRICAL and CHEMICAL laboratory owners, refer to our monthly laboratory contest on Page No. 1288, for prizes offered for laboratory pictures. We have not received any worth while photos for several months. Now is the time to get busy with that camera and take a photo of your "Lab," and do not forget one of yourself! The more good ones we get, the more we will publish, — so send us some "real Lab" photos by the very next mail, won't you?

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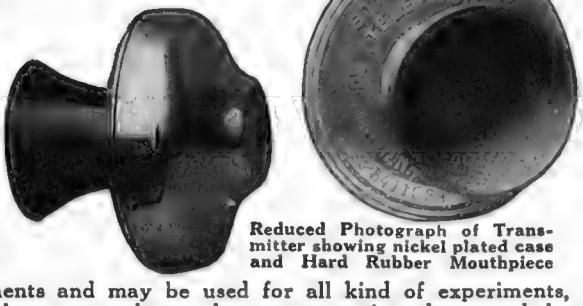

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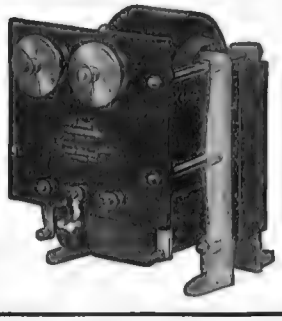

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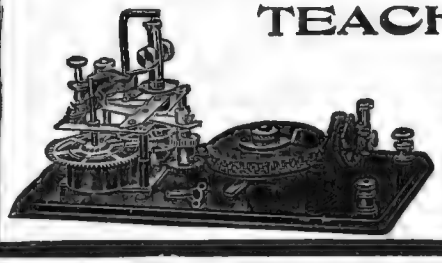

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Selective Wireless Control

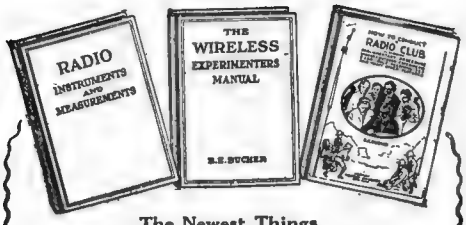
By EVERETT LEO DEETER

(*Continued from page* 1284)

other phenomenal qualities, before the thing is completely constructed. And don't dream about the Audions in diagram No. 2, for they are good ones, and these are used in place of a real old style coherer. The more bulbs the merrier. I used seventeen of them and saved the price of a relay, as you don't have to have one then, the relay action being quite strong indeed.

Open the door to diagram No. 4. The thumbscrew G holds the spring which pulls up the arm E thru the force of gravity, and thumbscrew A keeps it from pulling it on out into eternity. The one directly under the arm keeps the armature K from hitting the magnet cores. The two latter bolts set the arc thru which the arm E moves. It should come down just enough to move sprocket wheel one notch. The thumbscrew L is to adjust the wire connection between the two arms, which should be just tight when both arms are up, and allow the lower one to make contact at C. By sliding the arm B in the notch cut at end the time of raising of the sinker is varied, as it causes the float to go deeper in the water, thus taking it a longer time to raise. The spring arm U is to keep the wheel from moving back and to hold it in place. The coils may be from some discarded telegraph instrument, or may be hand-made and wound on a lathe, to about 15 ohms resistance. Both arms should be made of aluminum, and at least the one at the bottom, so as to lessen the weight on the float. The amount of water in the float will have to be tried by experiment. It then should be soldered water-tight, and onto the heavy wire arm (aluminum). The construction of the arm B is shown in the diagrams, as well as its support at N (diagram No. 1). The upper arm and magnets are mounted as shown in diagram No. 5. Diagram No. 4 gives details of a relay which can be made by the amateur, and coils should be about 1,000 ohms when combined. The rear of the board is shown in diagram No. 3. The switch segments are of copper and are nailed with brads, the connecting wire is wrapt around one brad and soldered. The brush C makes contact with the wheel B, on which the switch arm is connected. The switch should be made on the small board shown so that if at any time one should wish to add more points to his switch he could make a new board. He would also have to cut out another sprocket wheel. The brush C is connected to binding post G. The construction of bearings for the axle are given in diagrams. We can now consider the important features of the job as done, and the rest being a snap we will leave you to finish that yourself—we don't like snaps. My aerial snaps every time the wind blows.

Last on the curriculum is what to operate. The author had the following: An electric street car, battleship with cannon fired by electric spark, aimed at small German submarine which dipt out of sight as if blown apart; house lit by miniature lights; apparatus for raising flag by explosion in can; lights along railroad line and on battleship. These made a very attractive outfit to operate by wireless. There are many other interesting things that can be operated thus, and the enthusiastic amateur can think up plenty of them. But you will want to hunt for the nearest fire exit before you try some of them. And paste a diagram of your switch points on your sending outfit, with respective numbers, so you can tell how many times to push. "Good night."



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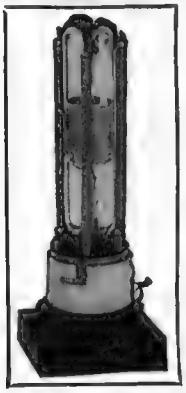

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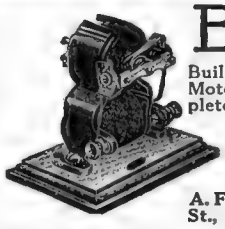

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The Educated Harpoon

By CHARLES S. WOLFE

(*Continued from page* 1256)

he invited, "come along. It's possible that an outsider might see something that we've all missed and you can't do any harm."

Nothing loathe, I accepted the invitation and rode down to the Atwood Building in the tonneau with Fenner. The Chief was busy driving and I managed to whisper to Fenner, "When did you get such a pull with the police?"

He gave an amused laugh. "Oh, I answer technical questions for them occasionally. My chief asset is the fact that few know that I have any interest in these affairs at all. You'll be a clam, I know."

The car stopped in front of the Atwood just then and I had no chance to question him further.

The Atwood was one of our skyscraper office buildings. The Chief entered the corridor, steered us into an elevator and we were whisked aloft. "Sixteenth floor," grunted the Chief to the operator, and we stept out into the corridor on that story.

Following Chief Davidson, we came to a suite of offices, the frosted glass of the door bearing the legend, "Corey & Co., General Offices." "Phew!" gasped Fenner. "Who was it? Not——?"

Davidson paused with his hand on the knob. "Yes, it was. Old John Corey and you can guess the commotion this'll make."

He flung open the door, and we filed in. The policeman on guard touched his cap in salute to his superior. We were in an outer office. Several desks were arranged around the room, and at one of them three girls huddled in a scared little group. One was sobbing softly. I noticed a man with his back toward us, looking out the window into space, apparently.

Paying no attention to the occupants of this room, Davidson strode across to a door marked "John Corey, Private." Opening it, he paused on the threshold. Fenner and I crowded at his back. Over his shoulder I could see into the inner office. A man, clad in a grey suit, was on the floor on his hands and knees. He looked up quickly.

"Come ahead," he said to the Chief, "you can't spoil any marks. There's nothing to spoil."

We entered.

Seated at a desk in the center of the room was a man. His head rested on the flat top of the desk, his arms flung forward before him. Davidson nodded toward him. "Just as he was found," he said, simply. It was my first sight of violent death.

Horror, or some other violent emotion, making my heart throb jerkily, I moved forward with Fenner, and looked down at the corpse.

A glance at the bowed back told the tale. The coat was soaked with blood, which had welled from a gaping wound below the left shoulder blade. I'll never tell you why I didn't faint. I wanted to.

Fenner turned to the man in grey. "What have you learned, Frank?" he asked.

Frank, who was evidently a detective, shook his head gloomily. "Nothing," he replied, "except what you see. He's been stabbed, that's evident, and whoever did it took the weapon away with him. But how he got in here, and how he got out, God alone knows. I've been over this floor on my hands and knees with a microscope. There's not a mark. Not a foot print in the dust, except those made by Corey himself. Nothing. Not a finger print on the walls,

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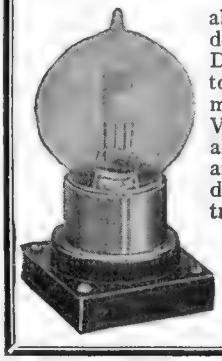

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on the desk, on the body, on the floor, on the door knob—inside or out—not anywhere. It's beyond me."

"Couldn't come in thru the outer office, ch?" Fenner's eyes were roving over the room. Frank shook his head slowly in negation. "Three girls and the head bookkeeper out there all evening, working overtime. All swear not one of them has been in this room this evening. Corey came in thru the outer office—the only way he could come in, for this office has only the one entrance—and closed the door. About half past eight one of the girls opened the door to come in. She saw that something had happened to Corey, and she didn't cross the threshold. All of them had sense enough to stay out. They telephoned for us. I was the first man in."

"No other doors?"

"Nope. Only one way in. Thru that office."

Fenner was gazing at the wall on the street side. "Did you open that window?" he asked.

"No. It was open. But it might as well have been bricked up for all the good it's going to do us. Corey opened it himself, no doubt. It's just sixteen stories to the street, and you can bet no one climbed up to it. It's five stories to the roof. One chance in one thousand that any one climbed down. It would take nerves of steel to drop over the edge on a rope, and if some one did have the nerve, they couldn't have gotten in that window noiselessly enough not to warn Corey. And just assuming that they did, they'd surely leave a mark doing it, wouldn't they?"

Fenner nodded. "They would indeed," he acquiesed. "How about the people in the office out there? Are they all above suspicion?"

"All above it," complained Frank, "and not only that, but the very number of them lets them out without question. It's not reasonable to suppose that three girls and a man, all trusted employees, would conspire to kill their employer without a motive for doing so. One of them might try it, or maybe even two, but it's hardly likely that all four would be against the man."

"Right you are," admitted Fenner, "I thought that way myself, but we have to eliminate the possibility of an inside job first. Well, Chief, I don't see that I can do you any good in this matter. It is unusual enough to be interesting, and if you don't mind I'll drop in and have a look around in the morning.

"Help yourself," gloomed Davidson. "I don't believe you can do anything in this case myself. I just took a chance. You might have, you know."

"I wish that I could have. And I'll look it over in the morning on the off chance. Good night, Frank, and good luck. Good night, Chief. Come on, Bill," And we left.

As we walked homeward, Fenner said: "It seems that the day of miracles is not gone by, after all. What do you think of that for a puzzle?"

"It's beyond me," I replied, soberly. "The only possible explanation that I can think of is that the man committed suicide."

Joe stood still and rocked with laughter. "Oh, Bill, Bill," he gasped, "there's only one man in a million—yes, I'll make it a billion—that commits suicide by stabbing himself in the back, to say nothing of calmly disposing of the weapon just after he's dead."

"Well, then," I demanded, sullenly, "how do you account for the thing?"

He grew thoughtful at once. "I can't," he admitted, "unless ——"

"Unless what?" I asked, as he paused.

"Unless—unless—well, I wouldn't want to say unless anything just now. Would you like to go down with me again tomorrow morning?"

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"I certainly would," I rejoined, instantly. "This thing's got my goat."

"All right, then. I'll stop for you on my way down."

I lay awake for hours trying to figure out how the thing could have been done. There didn't seem to be a plausible explanation. If the facts in the case had been handed to me as a sort of a puzzle, I would have said that it simply couldn't be done. And yet—there was the dead man.

Eventually I gave it up and fell into a restless slumber.

* * * * * * *

Next morning Fenner called for me as arranged. "Well," he asked, cheerfully, "have you solved the mystery over night?"

"No," I said. "It seems more baffling than ever after a night's thought. Have you found the answer?"

"Not yet. Do you happen to have a good pair of field glasses?"

I had, and I produced them. "That's fine," said Fenner after examining them. "Let's go."

We had no trouble getting into Corey's offices. The body had been removed, and practically all traces of the tragedy had disappeared.

Fenner dropped into the chair which so lately had been used by the hapless victim. As he sat at the desk his back was to the window, which had been closed.

"Well," he mused, "how was this man killed? If this chair could only talk. Suppose I was across the street in another building. Ah! Say I'm an old whaler. I have a harpoon and a coil of rope. The window is open in this office. That broad back is a fine target ——. Bill, look out that window and see if I couldn't do it."

I turned to Fenner, and in my most sarcastic tones I said: "You could, Joe, if you had an educated harpoon. After you threw it, it would pause cannily in mid-air, turn at an angle of forty-five degrees, leap agiley up about six stories, make another forty-five degree turn, slide gracefully thru the window, and ——."

But Fenner was on his feet and beside me. His face was grave, but his eyes twinkled. "Sufficient, William," he said, "your sarcasm is excellent, but I'm too busy to listen to the rest of it. Let's have those field glasses."

Ten minutes past. I began to grow fidgety, when he suddenly handed the glasses to me. "Bill," he said, "do you see that building out there—the one that appears to be as high as this one?"

"I do," I replied. "That could only be the Yeakle. It and the Atwood are the two tallest buildings we have."

"Well, look it over carefully, and tell me if you make out a clothes line on the roof."

I gazed. At first I didn't see one, but presently I located it. I told Fenner that there was undoubtedly a clothes line there.

"So I thought," he said, absently. "Well—let's call Davidson over here. It's up to him now."

I stared, amazed. "Up to him," I parroted. "What's up to him?"

"The arrest of the murderer," said Fenner, rather impatiently. "You're on to the thing, aren't you?"

"Do you mean that you know who killed Corey?" I asked, excitedly, as Fenner reached for the telephone.

He paused with his hand on the receiver. "No, I don't. But I know what he was killed with—and Davidson will find out the rest."

"Well," I demanded, "what was he killed with?"

Fenner called a number into the 'phone and gave me a sweet smile over his shoulder as he waited. "That chunk of clothes line, and——" he grew exceedingly sarcastic, "an educated harpoon."

Nor would he say more until Davidson, with Frank at his heels, burst into the room seething with excitement.

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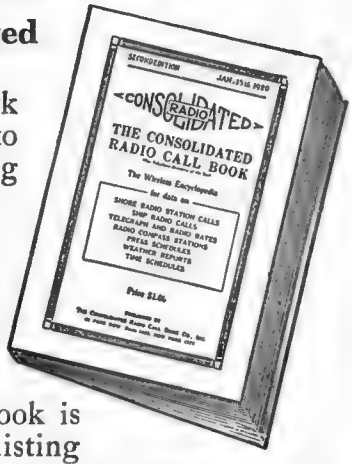

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"What's this, Joe," panted the Chief. "Find something? Got anything?"

Joe leaned back in his chair, and I saw that he was enjoying himself immensely. "Yes, Chief," he said, cheerfully, "I know what Corey was killed with."

The Chief darted a fiery glance at Frank. "Find it in here some place, did you?" he barked.

"No," I could positively feel Frank's relief, "but I know what it was done with."

"Damn," exploded the Chief. "So do I. It was a knife, but where——"

"Oh, no, it wasn't," smiled Fenner. "It was a harpoon."

The Chief's lower jaw sagged and Frank darted to the window. Then he turned back listlessly to Joe. "Come again, Fenner," he said. "It can't be done."

"Not from those buildings below very handy," admitted Joe, "but this harpoon came from the Yeakle."

The Chief laughed shortly. "That's a poor joke, Joe," he snapt. "The Yeakle is a good quarter of a mile away."

Fenner laughed. "Yes, but this was an *educated harpoon*," he said.

The detective Frank gave a sudden start. "I get you, Fenner," he yelled, and he was in motion while he spoke. "And I'll get him and bring him here."

"Hey," yelled the Chief, "What——"

But a slamming door was the only answer. Frank was gone.

Davidson turned to Fenner. "What kind of a game is this?" he demanded. "You're a pair of crazy asses, you and Frank. Now tell me what you're up to."

"Bright boy, Frank," observed Fenner, "it didn't take him long to tumble, once he got the tip. Now sit down and wait until he gets back."

For a half hour we waited in silence. Fenner smoked nonchalantly and refused to talk. The Chief fumed and paced the room. "A waste of time," he muttered again and again. The minutes dragged by.

And then the door opened and Frank pusht into our presence a swarthy little man with waxt mustaches and a decidedly foreign air. He was handcuffed. Two uniformed policemen came behind, bearing a long wooden box, which they placed on the desk. "Here's the bird, Chief," chortled Frank; "Fenner you're a dandy."

The Chief and I stared. "Sure you got the right man?" he demanded. Then to the prisoner, "What have you got to say? Remember, it may be used against you."

"There is nothing to say," said the prisoner, in perfect English, "except that I killed Corey——"

"You confess?" yelled the Chief.

The man shrugged hopelessly. "Confess!" he echoed, "what else is there to do? I suppose you want to know why. Well, because Corey ruined me financially. He stole my purse; I stole his life. But I'd like to know how you picked up the trail."

Fenner stept over to the unfortunate man. "I found it," he said, simply. "Why didn't you keep that clothes line of yours indoors?"

The man started, paled, then cried in anguish, "My God, I never thought of that. I could have, couldn't I?"

"You could," agreed Fenner, grimly, "and if you had, you never would have been caught. Send him over, Chief, and I'll tell you how the trick was done."

The man departed in charge of the two officers and Fenner tore the lid off the wooden box which the officers had brought. He turned to me. "And here, Bill," he said, mockingly, "is your educated harpoon."

And he placed before my astonished eyes an educated harpoon in very truth. It was a small airplane, wirelessly controlled, and its nose was a long, bayonet-like knife.

"Then the clothes line——"

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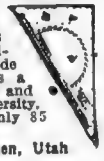

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The Chief finally broke the silence. "I think," he said, "that the educated harpoon is too dangerous a contrivance to survive. Science may need a lot of these *do-funny* things on it, but it will have to worry along without them. The details will not be made public, and just as soon as that man is convicted I'm going to personally destroy it."

Fenner nodded thoughtfully. "Yes," he agreed, "it's a shame to do it, but God help us all if its constructional features become known."

He lifted it tenderly and placed it in the wooden box. With the lid in his hand he paused, looking down. His eyes shown with the love of an enthusiast for the delicate, wicked, creation. "Good-bye, Educated Harpoon," he breathed.

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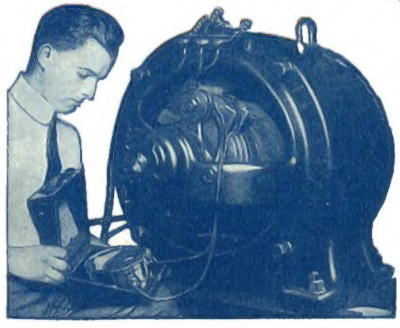

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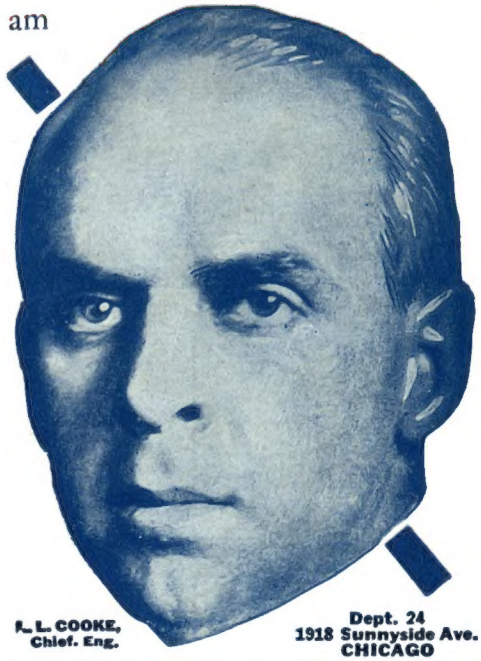

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